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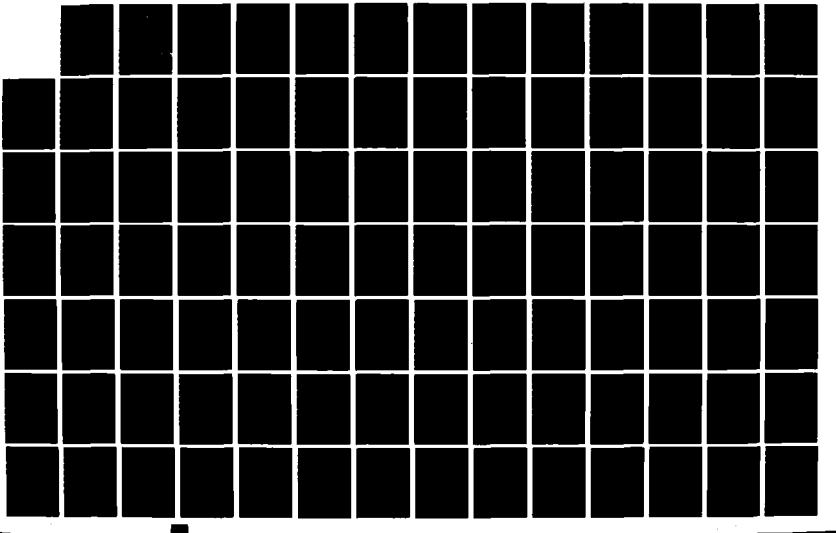

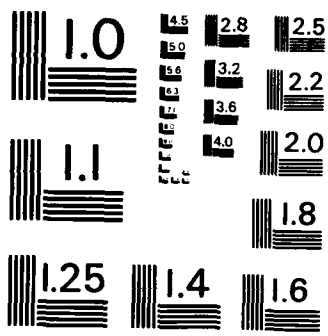

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CLAIMS FOR UNABSORBED OVERHEAD ON DEFENSE CONTRACTS

THESIS

Timothy E. Edem
First Lieutenant, USAF

AFIT/GSM/LSQ/85S-10

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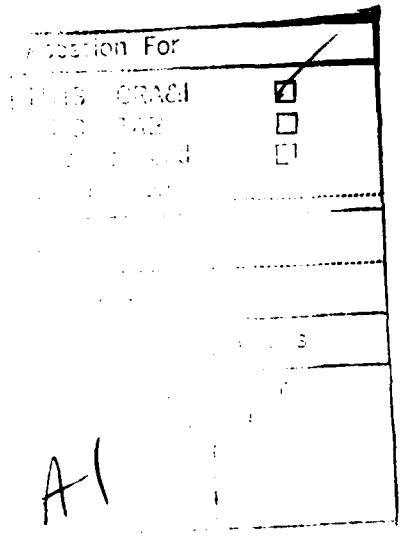
AFIT/GSM/LSQ/85S-10

CLAIMS FOR UNABSORBED OVERHEAD ON DEFENSE CONTRACTS

THESIS

Presented to the Faculty of the
School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Systems Management



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September 1985

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Abstract

This research effort investigated the Allegheny, Carteret, Eichleay, Allied Materials and Equipment Company, A.C.E.S. and Simulation formulas that were used or recommended to determine quantum on unabsorbed overhead claims. These claims arise from contracts that have been delayed by the government. When the government contracting officer and the contractor cannot come to an agreement, there is a claim filed by the contractor to the appropriate Board of Contract Appeals. These formulas investigated were the product of different claims heard before the appropriate Board of Contract Appeals, with the exception of one, the Simulation formula.

The analysis was accomplished by developing very basic examples which portray different aspects of the real world. Three examples were created, each one more extensive than the preceding. Then the true unabsorbed for each example was calculated. By using algebraic equations, each formula in this form was equated to the true unabsorbed. From this it was shown that the Allegheny and Allied Materials and Equipment Company formulas generally underestimate the true unabsorbed overhead. It also showed that the Eichleay, A.C.E.S., and Simulation formulas generally overestimate

true unabsorbed overhead. The Carteret formula did equate to the true unabsorbed overhead in each example, but not all real world situations were covered within this research. At least one more complexity needs to be examined.

CLAIMS FOR UNABSORBED OVERHEAD ON DEFENSE CONTRACTS

I. Introduction

Contractor claims on Department of Defense (DOD) construction contracts are a serious problem. This study focuses on the claims that are based on the premise of government caused delays. These claims are increasingly being appealed to the Armed Services Board of Contract Appeals (ASBCA). The results of these appeals have varied widely in the amount and method of settlement even when the cases were similar. This study takes an in-depth look at the various methods employed to determine claim amounts. Further, this study looks at the possibility of a standardized approach to contract claims caused by government imposed delays.

General Issue

The DOD has a problem when construction contracts are delayed due to actions of the government. When construction contracts are delayed, some overhead expenses continue during the delay which the contractor may not be able to charge to other jobs. For example, equipment may be rented and lease expenses paid, even as the equipment sits idly. These continuing overhead charges fall into three categories: "unabsorbed overhead," "underabsorbed

overhead," and "extended overhead." The categories of "unabsorbed overhead" and "underabsorbed overhead" are used synonymously. "Extended overhead" has a different meaning. All of these concepts will be explained in the section headed Key Terms.

The contractor has no way of knowing when he accepts a contract that possible government caused work stoppages or delays will occur, and therefore the original contract price does not anticipate these continuing expenses. When there are government caused work stoppages or delays, contractors file claims for additional funds. The process of appealing these claims has brought about the development of several formulas to estimate such unabsorbed overhead. The formulas may estimate widely varying amounts in a given situation. Since there exist several different compensating formulas which compute varying amounts, the general problem is evaluating the merits of the individual compensating formulas. The ultimate goal would be to construct a formula that equitably estimates unabsorbed overhead.

Key Terms

> OVERHEAD OR INDIRECT COST: Any cost not directly identified with a single final cost objective, but identified with two or more final cost objectives or with at least one intermediate cost objective. (CAS) [5:465].

CONTRACT BILLINGS: Accounts receivable or cash receipts for completed work or work in process.

DELAY: The authors define a delay as being a period of no work or lesser work than was required in order to perform the contract on a timely basis. For a price adjustment to be agreed to by the Government, the delay cannot have occurred through any fault of the contractor, even though the Government may have some responsibility also. Lastly, there must be some cost (detriment) which the contractor has suffered because of the delay. Thus a delay does not necessarily mean unabsorbed overhead. The delay must be coupled with a lack of work for a claim to be justified [5:347,356].

EXTENDED OVERHEAD: The meaning of this term now has a certain distinction. In the past the term extended overhead was used nearly the same as unabsorbed overhead, a cost that was not absorbed because the contract was delayed and no other work was found to replace the delayed work. So the contract was considered to be extended and this unabsorbed overhead was considered to be extended overhead. Now, extended overhead is considered to be overhead that continues due to a contract schedule extension. It has been ruled to be non-compensable as per the Capital Electric Company's GSBCA decision (7).

FISCAL YEAR: The accounting period for which annual financial statements are regularly prepared, generally a period of 12 months, 52 weeks, or 53 weeks. (CAS) [5:464].

FIXED OVERHEAD: Fixed costs remain relatively constant on a total basis, as production volume is varied over the short run. Examples of fixed costs include fire insurance, depreciation, rent, and property taxes [22:34].

VARIABLE OVERHEAD: "Variable costs fluctuate directly and proportionally on a total basis with changes in production volume over the short run. This means that when

volume of production increases, the total variable cost increases, and it increases the same amount for each additional unit of volume" (22:34). Examples of variable overhead costs include those of unemployment taxes, Social Security taxes up to the maximum taxable wage, etc.

> GENERAL AND ADMINISTRATIVE (G+A) EXPENSE: Any management, financial, and other expense which is incurred by or allocated to a business unit and which is for the general management and administration of the business unit as a whole. G+A expense does not include those management expenses whose beneficial or causal relationship to cost objectives can be more directly measured by a base other than a cost input base representing the total activity of a business unit during a cost accounting period. (CAS) [5:465].

> HOME OFFICE: An office responsible for directing or managing two or more, but not necessarily all, segments of an organization. It typically establishes policy for, and provides guidance to the segments in their operations. It usually performs management, supervisory, or administrative functions, and may also perform service functions in support of the operations of the various segments. An organization which has intermediate levels, such as groups, may have several home offices which report to a common home office. An intermediate organization may be both a segment and and a home office. (CAS) [5:465].

OVERHEAD RATE: The overhead rate is the ratio of indirect costs divided by direct cost. A fixed overhead rate is the ratio of fixed overhead divided by direct cost. Generally direct cost for overhead rates is direct labor dollars.

> REASONABLENESS: A cost is reasonable if, in its nature or amount, it does not exceed that which would be incurred by an ordinary prudent person in the

conduct of a competitive business. What is reasonable depends upon a variety of considerations and circumstances involving both the nature and amount of the cost in question [22:21].

UNABSORBED OR UNDERABSORBED OVERHEAD: That amount of indirect expense actually incurred which would have been allocable to the contract had the delay not occurred, and is not recovered in the revenue from any other work. Thus, what is involved here is a lower contract allocation base (or a non-existent one if contract work has stopped) in a situation in which indirect costs continue and no other work is substituted for the contract work not performed during the delay period. The objective of the accounting computation is to "normalize" the rate that would have been experienced had the delay not occurred, thereby leaving unchanged the allocation to other work. In theory, the sum of amounts allocated to the other work, when subtracted from the overhead pool, yields the unabsorbed overhead [5:347].

UNALLOWABLE COST: Any cost which, under the provisions of any pertinent law, regulation, or contract, cannot be included in prices, cost reimbursements, or settlements under a Government contract to which it is allocable. (CAS) [5:472].

BOARD OF CONTRACT APPEALS: "Judicial-type administrative boards, established in the various procuring agencies, which hear and decide disputes arising under contract "Disputes" clauses" (5:458). The process by which these boards get into the process is as follows: 1) There is a disagreement between the contractor and the government contracting officer. 2) The government contracting officer contacts AFLC/JAB as stated in the Air Force Federal Acquisition Regulation Supplement part 33; Protests, Disputes and Appeals, subpart 33.2; Disputes and Appeals, paragraph 33.211; Contracting Officer's Decision, subparagraph (a)(2), for consultation. 3) AFLC/JAB studies

the case and advises payment or approves of the government contracting officers final decision. 4) If the contractor does not agree with the government contracting officers final decision, the contractor formally files an appeal to the appropriate BCA. 5) The government contracting officer answers the appeal and then there is a period of time for discovery or records review. 6) The next period of time is consumed with the appeal attorney's preparation of the case by using interrogatories, requests for admissions, depositions, stipulations, and pre-hearing conferences. 7) The hearing is then held and briefs are exchanged with an eventual decision being handed down. The final decision may be appealed to a higher court.

Specific Problem

When the government causes delays in construction contracts, the contractors incur continuing overhead expenses that were not covered by the original price estimate. Since the DOD and a contractor have no way of knowing if a particular contract will be delayed, a standardized procedure to compensate for additional overhead expenses in delayed contracts would seem to be beneficial to both. At the present time there is no standard compensation formula. But, there is one formula, the "Eichleay formula", that is used in about 90% of all cases (23). Although the Eichleay formula seems to be widely liked and used by contractors, the problem of compensation for government

delays has continued to vary in methodology over the past thirty years. The amount of monetary compensation has varied also, and is the result of many different formula approaches. Thus, this study will concentrate on the reasonableness of the amount of monetary compensation that is awarded by the various formula methodologies.

Scope and Limitations

This research concerns specific contractor delay claims made against the DOD. Other claims have been instigated against the DOD caused by modifications, extensions and suspensions imposed by the government. Although these other claims at times get mingled with the term delay, the emphasis here will be delay orientated. The cases looked at will necessarily refer to a government caused delay.

In this research the word "case" will refer to cases that have been appealed to the ASBCA, unless otherwise stated. The reason for this definition is that the majority of cited material will come directly from cases pled before the ASBCA. Some material will cite references such as the General Services Board of Contract Appeals (GSBCA) and some will come from other levels of appeal claims.

Since this thesis researches the possibility of solving monetary claims in a seemingly more equitable fashion for contract delays, some areas of possible research will not be considered. The main area that will not be covered, is the many and varied reasons why military construction contracts

are sometimes delayed by governmental decisions. The reason for these limitations is that this research starts from the position of an already occurred contract delay. The reasons for contract delays is another research topic of probable importance.

Initial Discussion

Is there contractor incentive to absorb overhead during a delay? Are compensation formulas valid at all? Would a contractor who is delayed by governmental decisions perform no work and wait for a compensation formula to "make him whole"? No, there is contractor incentive to mitigate unabsorbed overhead even assuming all unabsorbed overhead would eventually be recovered from the government. The reasons for this are the following: 1) A delay period is a period of time where there is little or no work being performed which means it is a period of time where one is making little or no profit. A business venture is started for basically one and only one reason and that is to turn a profit and not a loss. 2) Also, during a delay period there are little or no billing receipts for the contractor who still has fixed costs to pay (rent, installment payments on equipment, payroll of salaried personnel and so forth). This requires the contractor to borrow or dip into savings to meet cash demands. He then incurs either extra nonrecoverable interest expense or a loss of earnings on savings. And 3) during a delay, unabsorbed overhead can be

claimed but a profit on unabsorbed overhead cannot be paid to a contractor, only his unabsorbed overhead cost. For these reasons there appears to be incentive to fill the government delay period with other work to lessen the impact of the unabsorbed overhead and to keep the contractors cash flow consistent. As far as compensation formulas being valid goes, this will be the subject of the main research problem and will be answered within the conclusion of this paper. The BCA's certainly feel that compensation formulas are valid or otherwise they would seek different alternatives when deciding cases.

Objectives

The first objective of this research is to examine the accounting merits of the various compensation formulas. Several formulas are now being used to calculate the additional unabsorbed overhead cost. These formulas originated through the process of the contractor taking the government to court. Because these formulas were invented for a particular delay, the invention of several formulas occurred. When no new formulas were invented, succeeding cases used whatever formula best represented the situation. The purpose of this objective is determine the "reasonableness" of each formula's calculated quantum.

The second objective is to prove by the use of algebraic equations that all the formulas do not equate to the true unabsorbed overhead. The equations will also show

that certain formulas will always over compensate and others will always under compensate unless the case involved is the most basic, uncomplicated claim that could exist.

II. Literature Review

Introduction

As stated under the general issue, there are three distinct words used with delay claims. These words are "unabsorbed overhead," "underabsorbed overhead," and "extended overhead." The distinction between these terms has been revealed in the section titled Key Terms and further explanations are part of some actual cases. When those particular cases are referred to, further differences between these terms will be observable.

This review of literature is presented in a chronological fashion because compensation decisions build upon court tested cases, which tend to set precedence for future cases. Six formulas were investigated for this review, their titles are as follows: "Allegheny," "Carteret," "Eichleay," "Allied Materials and Equipment Company," "A.C.E.S.," and "Simulation." These names were derived from the contractors who appealed for relief to Board of Contract Appeals. These formula names have been listed above in the order in which they were developed.

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The first case goes back to 20 May 1953 and the Allegheny Sportswear Company, a division of New York Pants Company Incorporated. Rather than construction contracting, this case involved the manufacturing of 35,000 field

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during the delay period to derive an "anticipated overhead." Anticipated overhead would represent the expected amount of overhead expenses recovered or absorbed during the delay period, using a normal recovery rate. Finally, the amount claimed by Carteret was the difference between actual overhead and anticipated overhead. Anticipated overhead would presumably be less than actual overhead during the delay period. Fixed overhead expenses would continue, but labor efforts during the delay period would be reduced. Overhead and general and administrative expense were both calculated on a percent of direct labor dollars.

Carteret suggested using two months for the actual percentage of direct labor dollars to be applied to three months that they claimed delay occurred. The government disputed this and said one month actual percentage should be used and should only be applied to two months in which delays occurred. The general process that was used is as follows.

Actual Overhead Rate	x	Actual Labor Dollars	=	Anticipated Overhead

then

Actual Overhead	-	Anticipated Overhead	=	Amount Claimed

(Source 18)

With the figures inserted for manufacturing overhead it looks like this:

38.25% x $22,587.18 = $8,639.60 Anticipated
Actual Overhead Rate (June) — Actual Labor Dollars (Aug + Sep) — Overhead

then

$21,997.56 - $8,639.60 = $13,357.96 Amount Claimed
Actual Overhead (Aug + Sep) — Anticipated Overhead — (Source 9)

This same procedure was used for general and administrative (G+A) expense. It appeared as the following:

24.35% x $22,587.18 = $5,499.98 Anticipated G+A Expense
Actual Overhead Rate (June) — Actual Labor Dollars (Aug + Sep)

then

$14,583.83 - $5,499.98 = $9,083.90 Amount Claimed
Actual Expense (Aug + Sep) — Anticipated G+A Expense — (Source 9)

So in conclusion the ASBCA determined the total of $13,357.96 and $9,083.90 was due the contractor, a total of $22,441.86. As will be discussed in Chapter IV, this particular compensation allocates all unrecovered overhead to this contract, generally overstating the Government's liability.

Allegheny - Revisited

The original Allegheny Sportswear Company case was reappealed to the ASBCA because there remained a conflict over the amount of compensation to be awarded. In the

initial Board decision on the Allegheny case, the amount of compensation was left up to the contracting officer, but the Board ruled that the contractor was due some reimbursement. Allegheny appealed the contracting officer's determination a second time questioning how much compensation should be awarded.

In the initial appeal the total amount asked for by the contractor was $29,143.50. But, after the initial appeal, Allegheny Sportswear Company sought additional accounting advice and resubmitted the claim, increasing it by $18,319.15 to $47,462.65 total. This was verified by a detailed breakdown of actual actions that took place during the total "stretched-out" contract. From this the Army Audit Agency reviewed their claim and "recommended $7,426 for acceptance as increased costs occasioned by the Government's delays in furnishing material" (3:6,364).

There is no detailed breakdown contained within this appeal showing what the Army Audit Agency found to be inaccurate or defective in terms of the Allegheny claim. Apparently though, the Army Audit Agency's computations gave birth to the Allegheny formula. The present day formula is as follows:

Incurred Overhead Rate During Actual Period Of Total Performance Including the Delay	-	Incurred Overhead Rate for Projected Performance Period	=	Excess Rate of Overhead

then

Excess Rate of x Base Costs = Unabsorbed
Overhead of Contract Overhead

(Source 18)

The reason for believing that this is probably the birthplace of this formula is the following statement from the case.

> This figure is predicated on the difference in overhead rates between the actual period of performance and the originally expected period of performance. It does not include any increases in direct cost, such as costs of training replacement operators or makeup pay originally included in the 19 December 1951 and 20 May 1952 statements of the claim [3:6364-6365].

The word figure in the above quote corresponds to the amount that the Army Audit Agency recommended as compensation to the contractor and as stated earlier it was $7,426.00.

After looking at the remaining evidence, this case ended with the confirmation that the original auditor was correct in his determination of the amount of reimbursement. The final opinion also added the cost that was substantiated for replacement of operators and make-up pay. Therefore, the total settlement to Allegheny Sportswear Company totaled $9,853.11. The assumption in the Allegheny formula is that the overhead rate would be lower during the actual period then during the projected period, because during the actual period fixed overhead expenses would continue with a reduced overhead labor base.

The important point of this case was the way the Army auditor calculated the additional compensation. What was written about this case indicates that the procedure to

figure the settlement, closely resembles the present day Allegheny formula. The opinion rendered by this case, therefore confirms the legitimacy of this type of calculation or formula (3:6361-6366).

Eichleay Formula

The Eichleay Formula received its name through the following appeal made by the Eichleay Corporation in 1960. The express purpose of this appeal was to determine "the amount of Home Office Expenses allocable to the delays" (16:13,565). The method of computation was the basic disagreement which led to this appeal. Each of the contracts contained a paragraph GC-11, titled "Suspension of Work" (16:13,506), which provided the necessary specifications to allow for this type of appeal.

"After correspondence and a series of conferences, the parties agreed on the amount of home office expense, or overhead costs, to be allocated to the delay periods of these contracts" (16:13,568). The government and Eichleay disagreed, however, on how these amounts were to be allocated. Another matter of determination that was considered and worked out was the length of delay each contract suffered. The length of delay, in terms of days, was very important because it was explicitly used in the appellant's formula. The formula, known as the Eichleay formula is as follows:

1. $\frac{\text{Contract Billing}}{\text{Total billings for the Contract period as extended}}$ X Total Overhead for contract period as extended = Overhead allocable to the contract

2. $\frac{\text{Allocable Overhead}}{\text{Days of performance}}$ = Daily Contract Overhead

3. Daily Contract Overhead X Number days Delay = Amount Claimed (16:13,568)

Computation 1 allocates the overhead to the contract based on the contract's percent of total business during the extended contract period. Computation 2 reduces this contract allocable overhead to a daily allocable contract overhead. Computation 3 then computes a total claim by adding for each delay day, one day's contract allocable overhead. Using the figures from one of the contracts in the case, this is how it worked.

1. $\frac{\$684,433.78}{\$10,961,044.03}$ = 6.25% X $1,320455.12 = $82,528.45

The delayed contract accounted for 6.25% of the contractor's total business, so was allocated 6.25% of the overhead.

2. $\frac{\$82,528.45}{504}$ = $163.75

As the total extended period was 504 days, the allocated overhead was $163.75 per day.

3. $163.75 X 194 = $31,767.50

Finally, for a delay of 194 days, the unabsorbed overhead is calculated. (16:13,569)

The Government computed the claim in a different

fashion, as "the ratio of the direct excess costs allowed on the suspension claim to all of the contractor's direct costs for the year 1955" (16:13,571). These computations for the same contract that was figured under the Eichleay formula were figured as follows under the government computations.

1. Contractor's direct costs on suspension claim	$ 22,313
2. Subcontractors' total costs (including overhead) on suspension claims	32,100
3. Total of Contractor's excess direct costs (1+2)	$ 54,413
4. Contractor's direct costs of all contracts for calendar year 1955	$7,374,449
5. Subcontractors' total excess (direct) costs	$ 74,403
6. Contractor's total direct costs (4+5)	$7,448,852
7. Percent of total excess direct costs on suspension claim to total direct costs (3-:-6)	.73%
8. Corporate overhead for calendar year 1955	$871,756
9. Corporate overhead allocable to excess direct costs (7x8)	$ 6,364

(16:13,571)

The whole problem of delays or suspensions is what to do with the workers and equipment in the event of these occurrences. Each contractors situation varies. Some contractors may have other contracts that could use the now unused workers and equipment. Yet, other contractors may not have other contracts or they may have other contracts

but, it is impractical to move the workers and equipment. This appeal stated that, "there is no exact method to determine the amount of such expenses to be allocated to any particular contract or part of a contract" (16:13,573). The opinion then went on to say, "it has been held a number of times that it is not necessary to prove a specific amount, but only to determine a fair allocation for the purpose of compensating a contractor for delay by the Government" (16:13,573).

The method of computation used by the appellant determines the expenses of the main office (overhead costs) basically by using the period of the suspension or delay. The formula, as well as certain circumstances contained within these claims, was objected to by the government. The following is the allegation by the government and the opinion by the ASBCA concerning the initial Eichleay claim (the allegation has been underlined):

1. Appellant has been inconsistent in the method of computation of its claim at various stages of the negotiations before the contracting officer's findings and determinations. It does not appear, however, that there is any dispute as to the basic figures upon which the computations are based. We need only decide what constitutes a fair and realistic allocation of the main office expenses.

2. The suspension applied to only about 50% of the work, and direct cost were continuously incurred on unaffected work. To the extent that overhead expenses were incurred which were applicable to the partial suspension, appellant is entitled to recover them. It is appropriate, in this connection, to use the entire contract as a

measure of the entire overhead allocable to the contract.

3. The greatest impact of main office expenses is felt in the early stages of performance. No data has been submitted to demonstrate the nature of the influence of this factor in the present situation. It is noted that the method here adopted is the one approved by the Court of Claims in the above-cited cases.

4. Main office contribution to these contracts is less than to appellant's commercial work because of the high percentage of subcontracting, and the fact that most of the work done by the prime contractor was labor. We fail to see how this factor is of sufficient significance to materially affect the applicability of the method of allocation approved by the Court of Claims to the facts of this case.

5. The procurement of additional work by way of unit increases and change orders involved no expense or effort to appellant. It is not shown that this affects the amount of home office expense allocable to idle time [16:13,575].

For the reasons stated above, given as the opinion in this case, it was concluded that the appellant's computation formula was a realistic method. Since this initial precedence, the Eichleay formula has been and, continues to be frequently used. In about 90% of all delay claims the appellant requests the use of the Eichleay formula.

Allied Materials and Equipment Company

The Allied Materials and Equipment Company formula is also known as the "burden fluctuation method". The appeal of the Allied Materials and Equipment Company was filed because their contract with the government was terminated. The company felt that duress was applied to their company

and that they had to go along with the termination settlement or face irreparable damages. After the pressure of duress had subsided, this appeal was made known in writing and accepted by the ASBCA in 1975.

The portion of this case that is important to this study is the calculation of the "unabsorbed burden." According to the government a delay of 376 days did occur on this contract. The opinion also states the following about "unabsorbed burden expense":

> The claim for unabsorbed burden expense bears no direct relationship to the direct and indirect expenses incurred on a particular contract, but arises because of a decrease in the allocability of the burdens a particular contract due to a reduction in the direct cost base in that contract during a period of disruption and delay which consequently causes the other work in the plant to sustain an increased allocation of the burdens over what would have been experienced if there had been no delay and disruption. We find the expense attributable to the Government which is liable therefor [4:53,089].

The Allied Materials and Equipment Company originally used the "Eichleay Formula." However the BCA determined the formula inappropriate in this case because "the claimed amount of $251,028 exceeds the actual unallocated residual manufacturing overhead and G+A expenses by approximately $145,915" (4:53,089). It was then determined that the "fluctuation method" would be more appropriate and this method is as follows:

		actual cost burden rate
(minus)	-	bid cost burden rate
(equals)	=	fluctuation burden rate

		total plant labor
(minus)	-	contract labor
(equals)	=	residual labor

fluctuation burden rate	X	residual labor	=	unabsorbed indirect factory expense

		actual cost burden rate for G+A
(minus)	-	bid cost burden rate for G+A
(equals)	=	fluctuation burden rate for G+A

		total manufacturing cost
(minus)	-	contract manufacturing cost
(equals)	=	residual manufacturing cost

fluctuation burden rate for G+A	X	residual manufacturing cost	=	unabsorbed G+A expense

		unabsorbed indirect factor expense
(plus)	+	unabsorbed G+A expense
(equals)	=	total unabsorbed overhead

(4:53,089-53,090)

Note: The fluctuation burden rate would generally correspond to what was called "excess rate of overhead" in the Allegheny method. Total plant labor equals all labor for the contractor during the extended period of the contract in dispute. From that figure is subtracted the amount of labor used on the contract in dispute. This gives the residual labor or excess labor base. The formula then takes the excess, or fluctuation, rate times the excess labor base to compute unabsorbed overhead. As shown, the same process is then used to calculate G+A, a home office expense.

Putting in the actual figures for this case and following through each of the above steps, the calculations appear as follows:

	31.65%	actual cost burden rate
-	27.00%	bid cost burden rate
	4.65%	fluctuation burden rate
	$438,895	total plant labor
-	377,533	contract labor
	$ 61,362	residual labor

4.65% X $61,362 = $2,853

	12.58%	actual cost burden rate for G+A
-	8.00%	bid cost burden rate for G+A
	4.58%	fluctuation burden rate for G+A
	$2,442,774	total mfg. cost
-	1,879,575	contract mfg. cost
	$ 563,199	residual mfg. cost

4.58% X $563,199 = $25,795

	$ 2,853	unabsorbed indirect factory expense
+	25,795	unabsorbed G+A expense
	$ 28,648	total unabsorbed overhead

(4:53,089-53,090)

There is a large difference between this amount of $28,648 versus the claimed amount of $251,028. These two amounts represent the difference between two compensating formulas, the "Eichleay" versus "fluctuation." From this point on the "fluctuation method" will be called the Allied Materials and Equipment Company formula. It should be noted that this is a variation of the Allegheny method, which also employs the difference of two indirect cost rates.

One last observation about this formula is that it seems to have been developed for a special circumstance. When a contractor bids lower than the anticipated overhead, possibly to get the contract, and then a delay occurs, the Government should not be held liable for overhead that is based on a rate greater than his bid rate.

A.C.E.S. Formula

The next distinctive method of compensation for delays is the A.C.E.S. formula. A.C.E.S. Incorporated appealed a Government termination and later reappealed to reach a determination on which items were of merit and the related amount to be compensated. The initial case dealt with the type of termination that was applied to the contract. The government called it a termination for default, while the appellant claimed termination for convenience of the government. The opinion of the first appeal stated that it was a "termination for the convenience of the Government" (1:67,712). Thus, this appeal was for claims that arose from the opinion of the first appeal.

There was a suspension in the acceptance of products that the A.C.E.S. Corporation used in this contract. This suspension was caused by the government and when the contractor was notified of this fact, they stopped all work on that contract.

In 1979, the contractor claimed that they "laid off about eleven workers and put others to work on another contract then being performed" (1:67,721). Thus, the contractor was making a claim for lost revenue that would have gone towards absorbing fixed overhead.

The opinion rendered on this portion of the appeal states that the "appellant is entitled to an equitable adjustment based on the underabsorption of fixed overhead

for the shut down days attributable to the Government suspension" (1:67,721). The formula used to calculate this portion of fixed overhead is as follows:

$$\frac{\text{fixed overhead costs}}{\text{total overhead costs}} = \text{fixed overhead rate}$$

Total overhead rate per labor hour X fixed overhead rate = fixed overhead rate per labor hour

Lost labor man-hours X fixed overhead rate per labor hour = unabsorbed overhead

(Source 18)

The basic assumption in this formula is that unabsorbed overhead is computed by multiplying a fixed hourly overhead rate with the number of hours that were lost from production, due to the delay. The actual figures and calculations particular to this case were as follows:

$$\frac{\$150{,}000 \text{ fixed overhead costs}}{\$252{,}000 \text{ total overhead}} = .60 \text{ fixed overhead rate}$$

Total overhead X .60 = $1.48 per hour
($2.47 per hour)

Lost labor hours = 1,056 hours
(11 men for 12 work days)

Equitable adjustment = $1,562.88
(1,056 hours X $1.48 per hour)
(1:67,722)

Unabsorbed overhead was also claimed by the appellant for the period of time the contract would have been in force had it not been terminated. On this separate issue the ASBCA rendered this decision, "As recognized by appellant in its main brief, continuing overhead costs of an enterprise which continues in business after a complete termination of

a contract have not been considered allowable as costs of the termination" (1:67,725). Thus, unabsorbed overhead expenses resulting from the termination of the contract were not allowable costs.

Simulation Method

This last formula or method of unabsorbed overhead calculations involves a concept that has not been tested by the appeals courts. It is a textbook solution developed in 1979 (Source 5)

> This method, called the simulation method, divides contract billings by the actual days worked to determine average contract billings per day worked. The daily average is then multiplied by the number of days of delay to simulate the work that would have been performed had the delay not occurred. This amount is added to both contract billings and total billings, and the resulting ratio is used to allocate total overhead to the contract. The total amount so allocated, less the amount allocated to actual work performed, yields the amount of the delay claim [14:13].

As stated above, this is how the simulation method appears as a formula:

$$\frac{\text{Contract Billings}}{\text{Actual Days Worked}} = \text{Average Contract Billings per day worked}$$

$$\text{Average Contract Billings per day Worked} \times \text{Number of Days of Delay} = \text{Simulated Additional Work}$$

$$\text{Simulated Additional Work} + \text{Contract Billings} = \text{Simulated Contract Billings}$$

$$\text{Simulated Additional Work} + \text{Total Billings} = \text{Simulated Total Billings}$$

Simulated Contract Billings / Simulated Total Billings	X	Total Home Office Overhead During Contract Period	=	Overhead Allocable To Contract

Overhead Allocable To Contract	-	Overhead Actually Allocated to Contract	=	Unabsorbed Overhead

(14:22)

Note: Contract Billings are equivalent to Original Contract Price as found in the Eichleay formula. Actual Days Worked is the number of days of the original contract. Total Billings is equal to the billings of the original contract period plus out of period costs on the contract in question. Total Home Office Overhead is the number of days in original contract plus the number of days in delay period, times the fixed daily overhead. Overhead Actually Allocated to the Contract is the amount of initially agreed upon for the contract in question. With sample figures inserted this is how the calculations would appear:

$1,100,000 / 360 (12 months X 30 days) = $3,055.55 per day (average daily contract billings)

$3,055.55 X 180 days delay (6 months X 30 days) = $550,000 (simulated additional work)

$550,000 + $1,100,000 = $1,650,000 (simulated contract billings)

$550,000 + $2,080,830 = $2,630,830 (simulated total billings)

$1,650,000 / $2,630,830 = 62.7% X $210,000 = $131,670 (simulated allocable overhead)

$131,670 - $126,000 = $5,670 Unabsorbed Overhead

(14:22)

The Simulation Method is somewhat similar to the Eichleay Method, and was developed by the authors of Government Contract Accounting. The two authors, Howard W. Wright and James P Bedingfield, have had a lot of valuable experience with Government contract accounting. In the area of Government contract delays, the authors' Simulation Method was derived to solve some of the perceived inequities of the Eichleay method.

Other Computation Methods

Some other known methods for compensating delay costs are the "Kurz & Root, Keco Industries, Shore-Calnevar, Therm-Air Mfg. Co. cases, but it appears these principles are less frequently used by the Board" (15:39,40). "The most frequently used method by the Armed Services Board of Contract Appeal (ASBCA) is called the 'Eichleay' formula or some variation thereof" (15:40). Robert Dick in his article, "Unabsorbed Overhead in Claims for Equitable Adjustment of Contract Prices of Defense Contracts," explains how he would vary the "Eichleay" formula to make it more useful for varying circumstances between contractual claims. He feels that the straight-forward "Eichleay" formula has its shortcomings and that it needs to be improved (15:40). Robert Dick explains one shortcoming as,

> The use of a daily rate results in attributing overhead costs to a delay occurred in the performance of one particular contract even if the contractor was able to mitigate the impact of the work interruption by adjusting his work schedules and substituting other work for the affected contract [15:41].

Regarding another shortcoming, Dick states that,

> The formula does not provide for any adjustment of the computed amount for that portion of fixed overhead costs which is allocable to any additional cost expended which exceeds the amount originally contemplated in negotiating the original contract price. Under certain circumstances, the final performance costs, including the claimed additional costs, may result in absorption of a higher amount of overhead than the original contract would have absorbed had there been no work interruption. In effect, the contract change may actually result in overabsorption of overhead [15:41].

Formula Debate

In a dispute involving National Homes Construction Corporation the type of formula to use for delayed overhead compensation was debated. The contract Price Analyst used the "Eichleay" method to calculate the overhead charges while the Defense Contract Audit Agency (DCAA) used the "Allegheny" method. After discussions it was decided that the "Eichleay" method did a better job of allocating fixed overhead and thus was used (20:3).

Another case encountered involved the contractor and the government already agreeing in principle that some compensation was due the contractor. The question at hand was, what amount of compensation is warranted? The judge felt that the "Eichleay" method was the right formula to be

used, but that the figures inserted into the formula were incorrect (10). Each new case seems to bring a new twist to this delayed military contractual compensation problem.

The GSBCA felt in 1979 that the Eichleay method was proper. They felt the Dawson Construction Company was found to be correct in using the "Eichleay" formula despite government auditors arguing that the "Eichleay" formula was not the proper method to use. The auditors felt that by "using Appellant's figures, it was possible to compute the total value of all items of work that could have been performed during the suspended period" (13:68,634). Because of this fact, the auditors believed that the Eichleay formula should not have been used since there was another practical method available. The GSBCA stated: "Accordingly, we conclude that in the absence of a contractually-prescribed method for allocating overhead, the Eichleay formula is not only acceptable but preferable to the method proposed by the Government" (13:68,635).

Turmoil in the Courts

In the case involving Capital Electric Company (1983), the distinction between extended and unabsorbed overhead arose. "Extended" overhead occurs when a construction contract is extended. In this case additional fixed overhead expenses are incurred, which are not recovered by the initial contract bid.

> The recovery of additional overhead for delay is generally permitted either on the theory that additional overhead costs are incurred when the contract period is extended or on the theory that the contract has not absorbed its share of overhead during the period when no work, or lesser amount than planned, has been accomplished [19:1408].

In a GSBCA decision on Capital Electric Company the issue of "extended" overhead versus "underabsorbed" overhead was carried further (7). Here "underabsorbed overhead was defined as, "the consequence of the increase in the rate of allocation of indirect costs to work other than that which is delayed or disrupted" (7:20). Also defined is "extended" overhead; it "is a concept unique to construction contracting. It has as its premise (a false premise, as it turns out) that extending the performance period will increase overhead costs" (7:20). In a concurring opinion, Administrative Judge Lieblich makes a couple of points very clear:

> (1) as far as this Board is concerned, there is no such thing as compensable extended overhead (as opposed to underabsorbed overhead) in construction contracts; and (2) assuming, in a given case, the Board concludes that the contractor has incurred compensable underabsorbed overhead costs, the Eichleay formula is not a proper method of calculating those costs [7:1].

Judge Lieblich than goes on to qualify his seemingly strong words about the "Eichleay" formula. He states, "If the parties agree that the Eichleay formula is the correct method of compensating the contractor, as they did in Marlin, but disagree on the figures to be used, the Board is

likely to accept their choice of formula and rule on the choice of figures" (7:2).

Concerning the GSBCA's opinion on extended overhead and the Eichleay formula, Robert Witte wrote an interesting article. The following comment and quote appear to reinforce the magnitude of the decision rendered by the GSBCA on the Capital Electric Company.

> A concurring opinion commented on the monumental task undertaken by Judge Phillips in his treatise in the main opinion and summarized the conclusion of the case as follows: "... the Government will never again go along with any payment to a contractor for 'extended overhead,' nor will it ever again agree to the application of the Eichleay formula to any overhead calculation in a construction case. Whether distinguished or overruled, those prior decisions will be dead letters hereafter [24:21].

A Legal Review of the Situation

In an article by Glen Darbyshire in the Georgia Law Review (1983), unabsorbed overhead and the Capital Electric case are discussed. "The price of a construction contract typically includes a percentage added for overhead to the projects estimated cost" (12:761).

> Before a contractor can recover home office overhead damages for delay, he must show either "underabsorption" of his overhead expenses by the delayed contract or "an increase" in overhead expenses caused by the delay. Courts impose these proof prerequisites to establish that the delay caused the contractor to suffer an actual loss [12:764].

"Fixed overhead costs increase in direct proportion to the length of a delay and do not vary with the contractor's

outlay on a particular project" (12:776).

> Segregating fixed and variable overhead expenses ultimately involves a question of fact: Is it more reasonable and fair to characterize the incurrence of a particular home office cost as directly related to the passage of time or to the contractor's direct cost outlays [12:779]?

"More importantly, the distinction between fixed and variable expenses determines the accounting formulas that accurately compute overhead damages" (12:780).

In the case of Capital Electric the author concludes:

> The board should have segregated the contractor's overhead costs and then applied both a direct cost formula for calculating variable overhead expenses and a time-based formula for calculating fixed expenses [12:796].

A Temporary Resolution

The case of Capital Electric Company and Savoy Construction Company went on to the United States Court of Appeals for the Federal Circuit (CAFC) (1984), and this court "affirmed in part; reversed in part; and remanded" (8:10; 21:10). This court reversed the portion that stated that the "Eichleay" formula would no longer be used; it was recommended for use and without modification (8:14). More recently (1984) the U.S. District Court for the District of Columbia determined, "A transit agency's rejection of a damage award because it was based on the Eichleay formula is improper" (17:91). They went on to cite:

> In Capital Electric Co. v. U.S. (41FCR290), the CAFC upheld the validity of the Eichleay formula as a means of calculating recoverable overhead in suspension of work cases, thus removing any basis

for the transit agency's deviation from the recommendation [17:91].

Summary

As can be seen from this review of literature, there clearly is a problem concerning how much compensation is due a government construction contractor when a contract has been suspended, or delayed. To determine the merit of a claim , the distinction between "unabsorbed" overhead and "extended" overhead had to be made clear. Since the most recent decisions on this subject contend that "extended" overhead will no longer be compensated, this is clearly an important distinction to be rendered.

After concluding that a contractor is due some compensation under the concept of "unabsorbed" overhead, a method or formula is needed to compute this amount. The two most widely known formulas are the "Eichleay" and the"Allegheny" methods. These methods have been hotly debated for several years. The May 1975 edition of the Defense Contract Audit Agency Pamphlet (DCAAP) 7641.45 favored the application of the "Allegheny" method. But when the DCAAP 7641.45 was revised in January 1983 it was not so adamant about using the "Allegheny" method. Instead, it included a fair overview of several formulas and gave a comparison example showing the varying amounts of compensation due a contractor using these different formulas. The "Eichleay" formula seems to be favored by the

ASBCA and the CAFC, but even then it is still debated.

The compensation issue is still very debatable, for the Capital Electric Company's decision rendered by the GSBCA in 1983 concluded that the "Eichleay" formula was no good. This problem now has gone full circle, right back to the start because, when this decision was appealed to the CAFC, they reversed the GSBCA's position on the "Eichleay" formula. The CAFC stated that damages should be calculated according to the "Eichleay" formula and so the debate continues.

The most recently published event (April 1985) has the ASBCA stating that, "regardless of any contracts received during the delay period, ...the contractor is entitled to recover extended home office overhead costs under the Eichleay formula" (6:755). Here again, the concept of extended overhead is brought up and is considered to be compensable. So now both items that were struck down by the GSBCA during the Capital Electric Company's appeal have resurfaced and are considered applicable once again. It is obvious that problems exist and in order for them to be rectified, more research, innovation, and testing need to take place.

III. Formula Examples

Introduction

This research problem was a type of experiment. The experiment was designed to analyze potential problems with existing compensation formulas. In order to view how each of these formulas calculated the amount of unabsorbed overhead, computer spreadsheet applications were used. From this, the reasonableness and accounting merits of each formula were better able to be evaluated.

Data Collection

The data compiled for this study was developed through a sequence of very simple examples. A simple case is extended twice, each extension creating a more general situation. These example figures were then entered into the varying unabsorbed overhead spreadsheet formulas. From this, the differences between each formula's calculated quantum could be compared and examined.

These examples and their representative calculated unabsorbed overhead figures are shown in tables within this chapter. Each example is described and then each spreadsheet is shown for that particular example. These tables of spreadsheet calculations are in the same sequence for each example. The sequence is Allegheny, Carteret, Eichleay, Allied Materials and Equipment Company, A.C.E.S. and Simulation.

Example 1

This first example is quite simple, but allows the reader to follow through the computations of each formula's deviation of unabsorbed overhead.

Circumstances. A two-man contractor, contracted with the government to install 320 new government furnished chalkboards in Air Force Institute of Technology (AFIT) classrooms. The contractor's fiscal year runs from 1 January through 31 December.

The contract called for installation beginning on 2 January 1988 and completion on 13 August 1988 (a period of 32 weeks or 160 work days). The chalkboards can be installed at the rate of 2 chalkboards per day. The chalkboards are not delivered until 24 April 1988 and immediately the contractor begins installation and finishes on 3 December 1988. The government caused a delay of 16 weeks or 80 work days due to the late delivery of the government furnished chalkboards. The number of work days is the product of the number of weeks times the number of work days per week. Throughout these examples, a standard 5 day work week is used.

The firm's owner receives a salary of $500 per week which is a fixed cost of doing business. Also, the contractor experiences other fixed costs of $200 per week which cover insurance, rent, and other various fixed costs. Therefore fixed overhead is $700 per week or $140 per work

day. The daily wage for the sole employee during the original contract period is $56.00 per work day. The fixed overhead rate is, then, the ratio of fixed overhead divided by direct cost, or $140/56 which equals 250%.

During the delay period of sixteen weeks the firm's owner is unable to find any work for the employee. The following computations, then, are required to compute unabsorbed overhead using the various formulas:

A. Total fixed overhead expenses, 48 weeks,
= $700 * 48 = $33,600 .

B. Total direct labor costs, 48 weeks,
= $56/day * 5 days/week X 32 weeks = $8,960 .

C. Fixed overhead rate, 48 weeks,
= $33,600 / $8,960 = 375% .

D. Total original contract period fixed overhead expenses, 32 weeks, = $700 * 32 = $22,400 .

E. Total original contract period direct labor expenses = $8,960 .

F. Original contract period fixed overhead rate
= $22,400 / $8,960 = 250% .

G. Assume the original contract price was computed as follows:

daily labor	$56
+ daily overhead	$140
	$196
+ profit (10%)	19.60
	$215.60 per day

or $215.60 * 160 = $34,496 .

H. Overhead rate per labor hour
= $140 / 8 = $17.50/hr.

I. The true unabsorbed overhead in this example would be $33,600 incurred, less $22,400 absorbed, or $11,200 .

Using this information, the formulas calculate the

unabsorbed overhead in the following ways shown in Tables 3.1 through 3.6. Explanatory footnotes for each formula are located at the bottom of each table.

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TABLE 3.1

	A		B		C		D		E
35					ALLEGHENY FORMULA				
36					---				
38	Incurred Overhead Rate	-			Incurred Overhead	=			Excess Rate of
39	During Actual Period				Rate for Projected				Overhead
40	(Original Plus Delay)				Performance Period				
41									
43	Enter Incurred				Enter Incurred				Calculated Excess Rate
44	Overhead Rate During				Overhead Rate for				of Overhead Now
45	Actual Period in				Projected Performance				Appears in Block E49
46	Block A49				Period in Block C49				
47									
49	3.75				2.50				1.25
50									
51									
53	Excess Rate of		X		Base Costs of	=			Unabsorbed Overhead
54	Overhead				Contract				
55									
57	Excess Rate of				Enter Base Costs of				Calculated Unabsorbed
58	Overhead Now Appears				Contract in Block C62				Overhead Now Appears
59	in Block A62								in Block E62
60									
62	1.25				8960.00				11200.00

FOOTNOTES:
1) Block A49 - see computation C, page 39
2) Block C49 - see computation F, page 39
3) Block C62 - see computation E, page 39
4) Block E62 - Allegheny Unabsorbed = True unabsorbed see computation I, page 39

TABLE 3.2

	A	B	C	D	E
2			CARTERET FORMULA		
3			---		
5	Actual Overhead Rate	X	Actual Labor Dollars	=	Anticipated Overhead
6	Before Delay Period		During Delay Period		During Delay Period
7					
9	Enter Actual Overhead		Enter Actual Labor		Calculated Anticipated
10	Rate in Decimal Form		Dollars in Block C14		Overhead Now Appears
11	in Block A14				in Block E14
12					
14	2.50		.00		.00
15					
16					
18	Actual Overhead	-	Anticipated Overhead	=	Amount Claimed
19	During Delay Period		During Delay Period		
20					
22	Enter Actual		Calculated Anticipated		Calculated Amount
23	Overhead in Block A27		Overhead Now Appears		Claimed Now Appears
24			in Block C27		in Block E27
25					
27	11200.00		.00		11200.00

FOOTNOTES: 1) Block A14 - see computation F, page 39
2) Block C14 - assumption of this example
3) Block A27 - see computation I, page 39

TABLE 3.3

	G		I		K		M
			EICHLEAY FORMULA				
	Original Contract Price	/	Total Billings for Actual Contract Period	X	Total Overhead Incurred During Actual Contract Period	=	Fixed Overhead Allocable to the Contract
	Enter Contract Price in Block G18		Enter Total Billings for Actual Contract Period in Block I18		Enter Total Overhead Incurred During Actual Contract Period in Block K18		Overhead Allocable to the Contract Now Appears in Block M18
	34496.00		34496.00		33600.00		33600.00
	Allocable Overhead	/	Actual Days of Contract Performance	=	Overhead Allocable to Contract Per Day		
	Allocable Overhead Now Appears in Block G34		Enter Actual Days of Contract Performance in Block I34		Calculated Overhead Allocable to Contract Per Day Now Appears in Block K34		
	33600.00		240		140.00		

TABLE 3.3 Continued

38	Daily Overhead	X	Number of Days of Delay	=	Unabsorbed Overhead
39					
40					
42	Daily Overhead		Enter Number of Days		Calculated Unabsorbed
43	is Now in		Delayed in Block I47		Overhead is now in
44	Block G47				Block K47
45					
47	140.00		80		11200.00

FOOTNOTES:
1) Block G18 - see computation G, page 39
2) Block K18 - see computation D, page 39
3) Block K48 - Eichleay Unabsorbed = True unabsorbed see computation I, page 39

TABLE 3.4

	A	B	C	D	E
70	ALLIED MATERIALS AND EQUIPMENT COMPANY FORMULA				
71					
73	Actual Cost	-	Bid Cost Burden	=	Fluctuation Burden
74	Burden Rate		Rate		Rate
75					
77	Enter Actual Cost		Enter Bid Cost		Calculated Fluctuation
78	Burden Rate in Decimal		Burden Rate in		Burden Rate Now
79	Form in Block A83		Decimal Form in		Appears in Block E83
80			Block C83		
81					
83	3.75		2.50		1.25
84					
85					
87	Total Plant Labor	-	Contract Labor	=	Residual Labor
88					
90	Enter Total Labor Cost		Enter Contract		Calculated Residual
91	in Block A95 (During		Labor in Block C95		Labor Now Appears in
92	Period Performed)				Block E95
93					
95	8960.00		8960.00		.00

TABLE 3.4 Continued

99	Fluctuation Burden Rate	X	Residual Labor	=	Unabsorbed Indirect Factory Expense
103	Fluctuation Burden Rate Now Appears in Decimal Form in Block A109		Residual Labor Now Appears in Block C109		Calculated Unabsorbed Indirect Factory Expense Now Appears in Block E109
109	1.25		.00		.00

FOOTNOTES:
1) Block A83 - see computation C, page 39 and Block A49 Allegheny formula
2) Block A95 - see computation E, page 39
3) In this simple case, the Allied Materials and Equipment Company formula is grossly inaccurate. No unabsorbed overhead is computed.

TABLE 3.5 Continued

145	Lost Labor Man Hours	X	Fixed Overhead Rate Per Labor Hour	=	Unabsorbed Overhead	
146						
147						
149	Enter Lost Labor Hours		Fixed Overhead Rate Per Labor Hour Now Appears in Block C154		Calculated Unabsorbed Overhead Now Appears in Block E154	
150	in Block A154					
151						
152						
154	640		17.5		11200.00	

FOOTNOTES:
1) Block A127 - see computation A, page 39
2) Block A141 - see computation H, page 39
3) Block E154 - A.C.E.S. unabsorbed = true unabsorbed see computation I, page 39

TABLE 3.5

	A	B	C	D	E
115			A.C.E.S. FORMULA		
116			---		
118	Fixed Overhead Costs	/	Total Overhead Costs	=	Fixed Overhead Rate
119					
121	Enter Fixed Overhead		Enter Total Overhead		Calculated Fixed
122	Costs in Block A127		Costs in Block C127		Overhead Rate Now
123					Appears in Decimal
124					Form in Block E127
125					
127	33600.00		33600.00		1.00
128					
129					
131	Total Overhead Rate	X	Fixed Overhead Rate	=	Fixed Overhead Rate
132	Per Labor Hour				Per Labor Hour
133					
135	Enter Total Overhead		Fixed Overhead Rate		Calculated Fixed
136	Rate Per Labor Hour		Now Appears in		Overhead Rate Per
137	in Block A141		Block C141		Labor Hour Now Appears
138					in Block E141
139					
141	17.5		1		17.5

TABLE 3.6

	A	B	C	D	E	F	G
160			SIMULATION FORMULA				
161			---				
163	Contract Billings	/	Actual Days Worked	=	Average Contract Billings Per Day Worked		
164							
165							
166							
168	Enter Contract		Enter Actual Days		Calculated Average		
169	Billings in Block A173		Worked in Block C173		Contract Billings now		
170					Appears in Block E173		
171							
173	34496.00		160		215.60		
174							
177	Average Contract	X	Number of Days	=	Simulated Additional		
178	Billings Per Day		of Delay		Work		
179	Worked						
180							
182	Average Contract		Enter Number of Days		Simulated Additional		
183	Billings Now Appears		Delay in Block C187		Work Now Appears		
184	in Block A187				in Block E187		
185							
187	215.60		80		17248.00		
188							
191	Simulated Additional	+	Contract Billings	=	Simulated Contract		
192	Work				Billings		
193							
195	Simulated Additional		Contract Billings Now		Calculated Simulated		
196	Work Now Appears in		Appears in Block C200		Contract Billings Now		
197	Block A200				Appears in Block E200		
198							
200	17248.00		34496.00		51744.00		

TABLE 3.6 Continued

204	Simulated Additional	+	Total Billings	=	Simulated Total Billings			
205	Work							
206								
208	Simulated Additional		Enter Total Billings		Calculated Simulated			
209	Work Now Appears in		in Block C213		Total Billings Now			
210	Block A213				Appears in Block E213			
211								
213	17248.00		34496.00		51744.00			
214								
217	Simulated Contract	/	Simulated Total Billings	X	Total Home Office Overhead During Contract Period	=	Overhead Allocable to Contract	
218	Billings							
219								
220								
222	Simulated Contract		Simulated Total		Enter Total Home		Calculated	
223	Billings Now Appears		Billings Now Appears		Office Overhead in		Overhead Now	
224	in Block A228		in Block C228		Block E228		Appears in	
225							Block G228	
226								
228	51744.00		51744.00		33600.00		33600.00	
229								
232	Overhead Allocable	-	Overhead Actually	=	Unabsorbed Overhead			
233	to Contract		Allocated to Contract					
234								
236	Overhead Allocable to		Enter Overhead		Calculated Unabsorbed			
237	Contract Now Appears		Actually Allocated to		Overhead Now Appears			
238	in Block A241		Contract in Block C241		in Block E241			
239								
241	33600.00		22400.00		11200.00			

FOOTNOTES: 1) Block A173 - see computation G, page 39
2) Simulation method unabsorbed = true unabsorbed see computation I, page 39

Example 1 Summary

In this basic example where the contractor obtained no work during the delay period the results can be summarized as shown in Figure 3.1 below.

	Understated Unabsorbed Overhead	Accurately Calculated Unabsorbed Overhead	Overstated Unabsorbed Overhead
Allegheny		X	
Carteret		X	
Eichleay		X	
Allied	X		
A.C.E.S.		X	
Simulation		X	

Figure 3.1 Example 1 Formula Results

As shown in Figure 3.1, each formula, except the Allied Materials and Equipment Company, computed the true unabsorbed overhead. The Allied Material and Equipment Company computed no unabsorbed overhead. In Chapter IV it will be seen that this example accurately reflects the general situation when no compensating work is obtained during the delay period.

Example 2

In the first example there was a contractor with one employee. In this second example the same circumstances

apply except that this contractor was able to find another contract during half of the delay period. Thus, his employee worked for 8 weeks (40 work days) during the 16 week (80 day) delay period. The employee was let go for 8 weeks (40 work days).

Circumstances. Again, the contractor's employee is paid $7.00 per hour or $56.00 per work day. Fixed overhead remains the same at $140 per work day and thus the overhead rate of 250% is also the same as Example one.

The difference between this example and example one is that the contractor bid on another contract when he was told of the delay of the chalkboards and his bid on this new contract was accepted. Two weeks had passed since the date of the chalkboard contract was to have begun, during these 10 work days the contractor's employee was let go. This new contract was then started on the 11th work day of the original delay and was finished at the end of the 50th work day. The contractor's employee was then let go again for another 30 work days for a total of 40 work days that he worked and 40 work days that he did not work.

This second intervening contract was worth $215.60 per work day, just as the Example 1 contract was computed (see computation G, page 39). For 40 days the total billing was $8,624. The opportunity labor lost was 40 work days times $56.00 which equals $2,240.00. With this it can be concluded that $5,600.00 was lost or is the amount of

unabsorbed overhead ($140.00 * 40 days).

The following computations, then, are required to compute unabsorbed overhead using the various formulas:

A. Total fixed overhead = $33,600 (see A, page 39).

B. Total direct labor costs, 48 weeks,
= $8,960 ÷ $56/day * 5 day/week * 8 weeks
= $8,960 ÷ $2,240 = $11,200 (see B, page 39).

C. Fixed overhead rate, 48 weeks,
= $33,600 / $11,200 = 300%.

D. Total original contract period fixed overhead expenses, 32 weeks = $22,400 (see D, page 39).

E. Total original contract period direct labor
= $8,960 (see E, page 39).

F. Contract fixed overhead rate
= 250% (see F, page 39).

G. Contract billings = $34,496 (see G, page 39).

H. Total extended billings
= $34,496 ÷ $8,624 = $43,120 .

I. Overhead rate / labor hour
= $17.50 (see H, page 39).

J. Unabsorbed overhead:

Total overhead (48 weeks)	= $33,600
Contract period (32 weeks absorbed)	= $22,400
Delay period (16 weeks)	$11,200
Delay period absorbed	$ 5,600
Unabsorbed	$ 5,600

Using this information the formulas calculated the unabsorbed overhead in the following ways shown in Tables 3.7 through 3.12. Again, explanatory footnotes are located at the end of each of the following tables.

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TABLE 3.7

	A		B		C		D		E
35					ALLEGHENY FORMULA				
36					---				
38	Incurred Overhead Rate	-			Incurred Overhead		=		Excess Rate of
39	During Actual Period				Rate for Projected				Overhead
40	(Original Plus Delay)				Performance Period				
41									
43	Enter Incurred				Enter Incurred				Calculated Excess Rate
44	Overhead Rate During				Overhead Rate for				of Overhead Now
45	Actual Period in				Projected Performance				Appears in Block E49
46	Block A49				Period in Block C49				
47									
49	3				2.50				.50
50									
51									
52									
53	Excess Rate of		X		Base Costs of		=		Unabsorbed Overhead
54	Overhead				Contract				
55									
57	Excess Rate of				Enter Base Costs of				Calculated Unabsorbed
58	Overhead Now Appears				Contract in Block C62				Overhead Now Appears
59	in Block A62								in Block E62
60									
62	.50				8960.00				4480.00

FOOTNOTES:
1) Block A49 - see computation C, page 54
2) Block C49 - see computation F, page 54
3) Block C62 - see computation E, page 54
4) Allegheny unabsorbed is <u>less</u> than true unabsorbed - see computation J, page 54

TABLE 3.8

	A	B	C	D	E
2			CARTERET FORMULA		
3					
5	Actual Overhead Rate	X	Actual Labor Dollars	=	Anticipated Overhead
6	Before Delay Period		During Delay Period		During Delay Period
7					
9	Enter Actual Overhead		Enter Actual Labor		Calculated Anticipated
10	Rate in Decimal Form		Dollars in Block C14		Overhead Now Appears
11	in Block A14				in Block E14
12					
14	2.50		2240.00		5600.00
15					
16					
18	Actual Overhead	-	Anticipated Overhead	=	Amount Claimed
19	During Delay Period		During Delay Period		
20					
22	Enter Actual		Calculated Anticipated		Calculated Amount
23	Overhead in Block A27		Overhead Now Appears		Claimed Now Appears
24			in Block C27		in Block E27
25					
27	11200.00		5600.00		5600.00

FOOTNOTES:
1) Block C14 - see computation B, page 54
2) Block A27 - see computation J, page 54
3) Carteret formula overhead = unabsorbed overhead - see computation J, page 54

TABLE 3.9

	G		I		K		M
			EICHLEAY FORMULA				
	Original Contract Price	/	Total Billings for Actual Contract Period	X	Total Overhead Incurred During Actual Contract Period	=	Fixed Overhead Allocable to the Contract
	Enter Contract Price in Block G18		Enter Total Billings for Actual Contract Period in Block I18		Enter Total Overhead Incurred During Actual Contract Period in Block K18		Overhead Allocable to the Contract Now Appears in Block M18
	34496.00		43120.00		33600.00		26880.00
	Allocable Overhead	/	Actual Days of Contract Performance	=	Overhead Allocable to Contract Per Day		
	Allocable Overhead Now Appears in Block G34		Enter Actual Days of Contract Performance in Block I34		Calculated Overhead Allocable to Contract Per Day Now Appears in Block K34		
	26880.00		240		112.00		

TABLE 3.9 Continued

38	Daily Overhead	X	Number of Days of Delay	=	Unabsorbed Overhead
39					
40					
42	Daily Overhead		Enter Number of Days		Calculated Unabsorbed
43	is Now in		Delayed in Block I47		Overhead is now in
44	Block G47				Block K47
45					
47	112.00		80		8960.00

FOOTNOTES:
1) Block G18 - see computation G, page 54
2) Block I18 - see computation H, page 54
3) Block K18 - see computation A, page 54
4) Eichleay formula overhead is greater than true unabsorbed - see computation J, page 54

TABLE 3.10

	A		B		C		D		E
	ALLIED MATERIALS AND EQUIPMENT COMPANY FORMULA								
	Actual Cost Burden Rate	-	Bid Cost Burden Rate			=	Fluctuation Burden Rate		
	Enter Actual Cost Burden Rate in Decimal Form in Block A83		Enter Bid Cost Burden Rate in Decimal Form in Block C83				Calculated Fluctuation Burden Rate Now Appears in Block E83		
	3.00		2.50				.50		
	Total Plant Labor	-	Contract Labor			=	Residual Labor		
	Enter Total Labor Cost in Block A95 (During Period Performed)		Enter Contract Labor in Block C95				Calculated Residual Labor Now Appears in Block E95		
	11200.00		8960.00				2240.00		

TABLE 3.10 Continued

99	Fluctuation Burden	X	Residual Labor	=	Unabsorbed Indirect Factory Expense
100	Rate				
101					
103	Fluctuation Burden		Residual Labor Now		Calculated Unabsorbed
104	Rate Now Appears in		Appears in Block C109		Indirect Factory
105	Decimal Form in				Expense Now Appears in
106	Block A109				Block E109
107					
109	.50		2240.00		1120.00

FOOTNOTES:
1) Block A83 - see computation C, page 54 and Allegheny Table 3.7
2) Block A95 - see computation B, page 54
3) Block E109 - Allied Materials and Equipment Company formula is less than true unabsorbed overhead

TABLE 3.11

	A	B	C	D	E
115			A.C.E.S. FORMULA		
116			---		
118	Fixed Overhead Costs	/	Total Overhead Costs	=	Fixed Overhead Rate
119					
121	Enter Fixed Overhead		Enter Total Overhead		Calculated Fixed
122	Costs in Block A127		Costs in Block C127		Overhead Rate Now
123					Appears in Decimal
124					Form in Block E127
125					
127	33600.00		33600.00		1.00
128					
129					
131	Total Overhead Rate	X	Fixed Overhead Rate	=	Fixed Overhead Rate
132	Per Labor Hour				Per Labor Hour
133					
135	Enter Total Overhead		Fixed Overhead Rate		Calculated Fixed
136	Rate Per Labor Hour		Now Appears in		Overhead Rate Per
137	in Block A141		Block C141		Labor Hour Now Appears
138					in Block E141
139					
141	17.5		1		17.5

TABLE 3.11 Continued

145	Lost Labor Man Hours	X	Fixed Overhead Rate Per Labor Hour	=	Unabsorbed Overhead
146					
147					
149	Enter Lost Labor Hours		Fixed Overhead Rate		Calculated Unabsorbed
150	in Block A154		Per Labor Hour Now		Overhead Now Appears
151			Appears in Block C154		in Block E154
152					
154	320		17.5		5600.00

FOOTNOTES:
1) Block A127 - see computation A, page 54
2) Block A141 - see computation I, page 54
3) Block E154 - A.C.E.S. computed overhead = true unabsorbed overhead - see computation J, page 54

TABLE 3.12

	A	B	C	D	E	F	G
160			SIMULATION FORMULA				
161			---				
163	Contract Billings	/	Actual Days Worked	=	Average Contract Billings Per Day Worked		
164							
165							
166							
168	Enter Contract		Enter Actual Days		Calculated Average		
169	Billings in Block A173		Worked in Block C173		Contract Billings now		
170					Appears in Block E173		
171							
173	34496.00		160		215.60		
174							
177	Average Contract	X	Number of Days	=	Simulated Additional		
178	Billings Per Day		of Delay		Work		
179	Worked						
180							
182	Average Contract		Enter Number of Days		Simulated Additional		
183	Billings Now Appears		Delay in Block C187		Work Now Appears		
184	in Block A187				in Block E187		
185							
187	215.60		80		17248.00		
188							
191	Simulated Additional	+	Contract Billings	=	Simulated Contract		
192	Work				Billings		
193							
195	Simulated Additional		Contract Billings Now		Calculated Simulated		
196	Work Now Appears in		Appears in Block C200		Contract Billings Now		
197	Block A200				Appears in Block E200		
198							
200	17248.00		34496.00		51744.00		

TABLE 3.12 Continued

204	Simulated Additional Work	+	Total Billings	=	Simulated Total Billings		
205							
206							
208	Simulated Additional Work Now Appears in Block A213		Enter Total Billings in Block C213		Calculated Simulated Total Billings Now Appears in Block E213		
211							
213	17248.00		43120.00		60368.00		
214							
217	Simulated Contract Billings	/	Simulated Total Billings	X	Total Home Office Overhead During Contract Period	=	Overhead Allocable to Contract
218							
219							
220							
222	Simulated Contract Billings Now Appears in Block A228		Simulated Total Billings Now Appears in Block C228		Enter Total Home Office Overhead in Block E228		Calculated Overhead Now Appears in Block G228
223							
224							
225							
226							
228	51744.00		60368.00		33600.00		28800.00
229							
232	Overhead Allocable to Contract	-	Overhead Actually Allocated to Contract	=	Unabsorbed Overhead		
233							
234							
236	Overhead Allocable to Contract Now Appears in Block A241		Enter Overhead Actually Allocated to Contract in Block C241		Calculated Unabsorbed Overhead Now Appears in Block E241		
237							
238							
239							
241	28800.00		22400.00		6400.00		

FOOTNOTES:
1) Block A173 - see computation G, page 54
2) Block C213 - see computation H, page 54
3) Block E241 - Simulation computed overhead is greater than true unabsorbed - see computation J, page 54

Example 2 Summary

This example extended and generalized Example 1 by assuming the contractor's employee obtained additional work during 1/2 of the delay period. The formulas yielded a variety of results which can be summarized as shown in Figure 3.2 below.

	Understated Unabsorbed Overhead	Accurately Calculated Unabsorbed Overhead	Overstated Unabsorbed Overhead
Allegheny	X		
Carteret		X	
Eichleay			X
Allied	X		
A.C.E.S.		X	
Simulation			X

Figure 3.2 Example 2 Formula Results

Note that the Allegheny and Allied Materials and Equipment Company results are similar. Employing an excess or fluctuating burden rate appears to underestimate unabsorbed overhead. The Eichleay and Simulation formulas also lead to similar conclusions. Both appear to underestimate the amount of overhead absorbed by non-contract work. In Chapter IV it will be seen that these apparent conclusions are, in fact, valid regarding these formulas.

Example 3

Example number three further generalizes the situation. This time the contractor has two employees who work on the contract full time. During the delay one employee is let go and the other works for one half of the delay period or 40 work days. Thus, one employee works 40 work days during the 80 work day delay and the other employee does not work at all during the delay.

Circumstances. The contractor's employees are each paid $7.00 per hour, a total of $112.00 per work day. Fixed overhead remains the same at $140 per work day. The contract overhead rate is now 125% because of the larger direct labor base ($140 / $112 = 125%).

As in example two, similar circumstances surround this contractor. Again, the contractor bid on another contract when he was told of the delay of the chalkboards and his bid on this new contract was accepted. Ten work days had passed since the date the chalkboard contract was to begin and during these ten work days the two employees of the contractor were let go. This new contract was then started on the 11th work day of the original delay and was finished at the end of the 50th work day. But, this intervening contract only required the recalling of one of the contractor's employees. This recalled employee was then let go for another 30 work days. Thus, one employee worked 40 days of the delay period, and was laid off 40 days of the

delay period. The other employee did not work at all during the 80 day delay.

The distinction between this situation and the previous can be viewed in at least two equivalent forms. In Example 2 the contractor found additional work during 1/2 of the 80 day delay period, so 40 contract equivalent days of work were obtained. Here, a contract equivalent day would be worth $112 in labor. The total labor during the delay period was $56/day for 40 days, or $2,240. This total is 20 contract equivalent days. Consequently unabsorbed overhead would be $140/day for 60 "non-contract equivalent" days or $8,400. Another way of viewing this situation is to compare the average daily labor cost during the delay period ($56/day * 40 days = $2,240 total labor; for the 80 day delay period this is $28 per day) with the average daily labor cost during the planned contract performance ($112 per day). In this manner, a delay day absorbed 25% (28/112) of the daily fixed overhead. So, total unabsorbed overhead would be 75% * 80 days * $140/day , or again, $8,400 . The following computations are required to compute unabsorbed overhead using the various formulas:

A. Total fixed overhead = $33,600 (see A, page 54).

B. Total direct labor costs, 48 weeks

contract:	$17,920	($8,960 * 2)
delay period:	$ 2,240	($56 * 40 days)
total	$20,160	(see B, page 54).

C. Fixed overhead rate, 48 weeks,
= $33,600 / 20,160 = 167%

D. Total original contract period fixed overhead expenses, 32 weeks = $22,400 (see D, page 54)

E. Original contract period overhead rate = 22,400 / 17,920 = 125%

F. Contract Billings

daily labor	$112
daily overhead	140
	$252
profit (10%)	25.20
	$277.20 per day or
	$44,352 for 160 days

G. Total billings, 48 weeks

We assume that billings for any job employ an overhead rate applied to direct labor plus a profit rate applied to total cost. Here, the overhead rate is 125% (part E) and the profit rate is 10% (part F). So daily delay billings would be (for 40 days):

labor	$56
overhead	70
	$126
profit	12.60
	$138.60

Total Billings

contract	$44,352
delay	5,544
total	$49,896

H. Hourly overhead rate = $17.50 (see I, page 54)

I. Total fixed expenses for delay period, 16 weeks = $140 * 5 * 16 = $11,200

J. Unabsorbed overhead = $8,400 as discussed above

Using this information the formulas calculated the unabsorbed overhead in the following ways shown in Tables 3.13 through 3.18. Explanatory footnotes will appear at the end of each table.

TABLE 3.13

	A	B	C	D	E
35			ALLEGHENY FORMULA		
36			---		
38	Incurred Overhead Rate	-	Incurred Overhead	=	Excess Rate of
39	During Actual Period		Rate for Projected		Overhead
40	(Original Plus Delay)		Performance Period		
41					
43	Enter Incurred		Enter Incurred		Calculated Excess Rate
44	Overhead Rate During		Overhead Rate for		of Overhead Now
45	Actual Period in		Projected Performance		Appears in Block E49
46	Block A49		Period in Block C49		
47					
49	1.67		1.25		.42
50					
51					
53	Excess Rate of	X	Base Costs of	=	Unabsorbed Overhead
54	Overhead		Contract		
55					
57	Excess Rate of		Enter Base Costs of		Calculated Unabsorbed
58	Overhead Now Appears		Contract in Block C62		Overhead Now Appears
59	in Block A62				in Block E62
60					
62	.42		17920.00		7466.67

FOOTNOTES:
1) Block A49 - see computation C, page 68
2) Block C49 - see computation E, page 69
3) Block C62 - see computation B, page 68
4) Block E62 - Again, Allegheny underestimates unabsorbed overhead

TABLE 3.14

	A	B	C	D	E
2			CARTERET FORMULA		
3			---		
5	Actual Overhead Rate	X	Actual Labor Dollars	=	Anticipated Overhead
6	Before Delay Period		During Delay Period		During Delay Period
7					
9	Enter Actual Overhead		Enter Actual Labor		Calculated Anticipated
10	Rate in Decimal Form		Dollars in Block C14		Overhead Now Appears
11	in Block A14				in Block E14
12					
14	1.25		2240.00		2800.00
15					
16					
18	Actual Overhead	-	Anticipated Overhead	=	Amount Claimed
19	During Delay Period		During Delay Period		
20					
22	Enter Actual		Calculated Anticipated		Calculated Amount
23	Overhead in Block A27		Overhead Now Appears		Claimed Now Appears
24			in Block C27		in Block E27
25					
27	11200.00		2800.00		8400.00

FOOTNOTES:
1) Block A14 - see computation E, page 69
2) Block C14 - see computation B, page 68
3) Block A27 - see computation I, page 69
4) Block E27 - Again, Carteret accurately estimates unabsorbed overhead

TABLE 3.15

G		H	I		J	K		L	M
			EICHLEAY FORMULA						

Original Contract Price	/		Total Billings for Actual Contract Period	X		Total Overhead Incurred During Actual Contract Period	=		Fixed Overhead Allocable to the Contract
Enter Contract Price in Block G18			Enter Total Billings for Actual Contract Period in Block I18			Enter Total Overhead Incurred During Actual Contract Period in Block K18			Overhead Allocable to the Contract Now Appears in Block M18
44352.00			49896.00			33600.00			29866.67
Allocable Overhead	/		Actual Days of Contract Performance	=		Overhead Allocable to Contract Per Day			
Allocable Overhead Now Appears in Block G34			Enter Actual Days of Contract Performance in Block I34			Calculated Overhead Allocable to Contract Per Day Now Appears in Block K34			
29866.67			240			124.44			

TABLE 3.15 Continued

38	Daily Overhead	X	Number of Days of Delay	=	Unabsorbed Overhead
39					
40					
42	Daily Overhead		Enter Number of Days		Calculated Unabsorbed
43	is Now in		Delayed in Block I47		Overhead is now in
44	Block G47				Block K47
45					
47	124.44		80		9955.56

FOOTNOTES:
1) Block G18 - see computation F, page 69
2) Block I18 - see computation G, page 69
3) Block K18 - see computation A, page 68
4) Block K47 - Again, Eichleay overstates unabsorbed overhead

TABLE 3.16

	A	B	C	D	E
70	ALLIED MATERIALS AND EQUIPMENT COMPANY FORMULA				
71					
73	Actual Cost	-	Bid Cost Burden	=	Fluctuation Burden
74	Burden Rate		Rate		Rate
75					
77	Enter Actual Cost		Enter Bid Cost		Calculated Fluctuation
78	Burden Rate in Decimal		Burden Rate in		Burden Rate Now
79	Form in Block A83		Decimal Form in		Appears in Block E83
80			Block C83		
81					
83	1.67		1.25		.42
84					
85					
87	Total Plant Labor	-	Contract Labor	=	Residual Labor
88					
90	Enter Total Labor Cost		Enter Contract		Calculated Residual
91	in Block A95 (During		Labor in Block C95		Labor Now Appears in
92	Period Performed)				Block E95
93					
95	20160.00		17920.00		2240.00

TABLE 3.16 Continued

99	Fluctuation Burden	X	Residual Labor	=	Unabsorbed Indirect Factory Expense
100	Rate				
101					
103	Fluctuation Burden		Residual Labor Now Appears in Block C109		Calculated Unabsorbed Indirect Factory Expense Now Appears in Block E109
104	Rate Now Appears in				
105	Decimal Form in				
106	Block A109				
107					
109	.42		2240.00		933.33

FOOTNOTES:
1) Block A83 - see computation C, page 68
2) Block C83 - see computation E, page 69
3) Block A95 - see computation B, page 68
4) Block E109 - Again, Allied underestimates true unabsorbed overhead

TABLE 3.17

	A	B	C	D	E
115			A.C.E.S. FORMULA		
116			---		
118	Fixed Overhead Costs	/	Total Overhead Costs	=	Fixed Overhead Rate
119					
121	Enter Fixed Overhead		Enter Total Overhead		Calculated Fixed
122	Costs in Block A127		Costs in Block C127		Overhead Rate Now
123					Appears in Decimal
124					Form in Block E127
125					
127	33600.00		33600.00		1.00
128					
129					
131	Total Overhead Rate	X	Fixed Overhead Rate	=	Fixed Overhead Rate
132	Per Labor Hour				Per Labor Hour
133					
135	Enter Total Overhead		Fixed Overhead Rate		Calculated Fixed
136	Rate Per Labor Hour		Now Appears in		Overhead Rate Per
137	in Block A141		Block C141		Labor Hour Now Appears
138					in Block E141
139					
141	17.5		1		17.5

TABLE 3.17 Continued

145	Lost Labor Man Hours	X	Fixed Overhead Rate Per Labor Hour	=	Unabsorbed Overhead	
146						
147						
149	Enter Lost Labor Hours		Fixed Overhead Rate		Calculated Unabsorbed	
150	in Block A154		Per Labor Hour Now		Overhead Now Appears	
151			Appears in Block C154		in Block E154	
152						
154	960.00		17.5		16800.00	

FOOTNOTES:
1) Block A127 - see computation A, page 68
2) Block A154 - 40 days employee 1 and 80 days employee 2
3) Block E154 - Unlike Example 2, the A.C.E.S. formula overstates unabsorbed overhead in this example

TABLE 3.18

	A	B	C	D	E	F	G
160			SIMULATION FORMULA				
161			---				
163	Contract Billings	/	Actual Days Worked	=	Average Contract Billings Per Day Worked		
168	Enter Contract Billings in Block A173		Enter Actual Days Worked in Block C173		Calculated Average Contract Billings now Appears in Block E173		
173	44352.00		160		277.20		
177	Average Contract Billings Per Day Worked	X	Number of Days of Delay	=	Simulated Additional Work		
182	Average Contract Billings Now Appears in Block A187		Enter Number of Days Delay in Block C187		Simulated Additional Work Now Appears in Block E187		
187	277.20		80		22176.00		
191	Simulated Additional Work	+	Contract Billings	=	Simulated Contract Billings		
195	Simulated Additional Work Now Appears in Block A200		Contract Billings Now Appears in Block C200		Calculated Simulated Contract Billings Now Appears in Block E200		
200	22176.00		44352.00		66528.00		

TABLE 3.18 Continued

204	Simulated Additional	+	Total Billings	=	Simulated Total		
205	Work				Billings		
206							
208	Simulated Additional		Enter Total Billings		Calculated Simulated		
209	Work Now Appears in		in Block C213		Total Billings Now		
210	Block A213				Appears in Block E213		
211							
213	22176.00		49896.00		72072.00		
214							
217	Simulated Contract	/	Simulated Total	X	Total Home Office	=	Overhead
218	Billings		Billings		Overhead During		Allocable to
219					Contract Period		Contract
220							
222	Simulated Contract		Simulated Total		Enter Total Home		Calculated
223	Billings Now Appears		Billings Now Appears		Office Overhead in		Overhead Now
224	in Block A228		in Block C228		Block E228		Appears in
225							Block G228
226							
228	66528.00		67207200		33600.00		31015.38
229							
232	Overhead Allocable	-	Overhead Actually	=	Unabsorbed Overhead		
233	to Contract		Allocated to Contract				
234							
236	Overhead Allocable to		Enter Overhead		Calculated Unabsorbed		
237	Contract Now Appears		Actually Allocated to		Overhead Now Appears		
238	in Block A241		Contract in Block C241		in Block E241		
239							
241	31015.38		22400.00		8615.38		

FOOTNOTES:
1) Block A173 - see calculation G, page 69
2) Block C213 - see calculation G, page 69
3) Block E228 - see calculation A, page 68
4) Block E241 - Again, the Simulation method overstates unabsorbed overhead

Example 3 Summary

This example extended and generalized Example 2 by assuming 2 contractor employees, one who worked 1/2 time during the delay. The other did not work at all during the delay. The formulas yielded a variety of results which can be summarized as shown in Figure 3.3 below.

	Understated Unabsorbed Overhead	Accurately Calculated Unabsorbed Overhead	Overstated Unabsorbed Overhead
Allegheny	X		
Carteret		X	
Eichleay			X
Allied	X		
A.C.E.S.			X
Simulation			X

Figure 3.3 Example 3 Formula Results

These categorizations will be shown to be generally valid in Chapter IV.

Data Analysis

Using the examples to see the very simple case of an unabsorbed overhead claim, the true unabsorbed overhead can be calculated. This true unabsorbed overhead can then be put into algebraic form along with each of the discussed formulas. The development of the true unabsorbed overhead formula was a great milestone that allows for this data

analysis.

Each formula is then compared with the true unabsorbed overhead formula. From this an explanation of why a particular formula is inaccurate can be attained. Thus, certain conclusions and recommendations can be drawn from these comparisons.

IV. Formula Equations

Introduction

In Chapter III, three situations were presented with given cost data. Then each unabsorbed overhead formula was applied to the given data. The results were then compared with true unabsorbed overhead. In this chapter, using simple algebra, each formula is compared with the formula for true unabsorbed overhead to reach general conclusions. To do this, symbols are developed to correspond with each variable in the formulas. The simplified algebraic formulas in this chapter appear in blocks corresponding with the computer spreadsheet tables found in Chapter 3. For example, Table 3.1 is Allegheny Example one and Table 4.1 is the Allegheny algebraic formula number one based upon example one.

In order to compare these formulas with the actual unabsorbed overhead, the true unabsorbed overhead algebraic formulas are developed. Using the three examples, each one more general than the preceding, three true unabsorbed overhead algebraic formulas are developed. The first one covers Tables 4.1 through 4.6, the second one covers Tables 4.7 through 4.12, and the third true unabsorbed overhead formula covers Tables 4.13 through 4.18. Then each final simplified formula is compared to the true unabsorbed

formula to determine whether that formula accurately estimates unabsorbed overhead.

Algebraic Variable Development

The following is a list of the variables needed to derive the unabsorbed overhead formulas and to derive the true unabsorbed overhead formula in each example.

C1 = Average Daily Direct labor cost During the D1 day Original Contract Period
C2 = Average Daily Direct Labor cost During the D2 day Delay Period
D1 = The Original Contract Period in Days
D2 = Delay Period in Days
D3 = Work Days Found During the Delay Period
F = Daily Fixed Overhead

This list of variables is all that is required to put all of the unabsorbed overhead formulas in algebraic equations. Now it is just a matter of working through each example with the six different formulas. Some common expressions that occur in the unabsorbed overhead formulas are the following:

A: Total overhead expense for the extended contract period = F * (D1 + D2)

B: Total contract direct labor = D1 * C1
Note: In all 3 examples this is also the total contractor direct labor during the original D1 day contract period.

C: Total delay period direct labor = D2 * C2 , so total extended period direct labor is D1C1 +D2C2

D: Original Contract period overhead rate = F / C1

E: Total extended period overhead rate = F(D1+D2) / D1C1 + D2C2
It is assumed that the contract and any work during the delay period are bid (priced) at direct labor plus overhead applied at the contract period

overhead rate plus a fixed profit rate, P. As long as the profit rate is fixed for all contracts, its value is immaterial, the two methods that use billings (Eichleay and Simulation) divide contract (simulated contract) by total (simulated total) billings. So, whatever the value of P it would cancel in this ratio. Consequently profit rates are not an issue in these unabsorbed overhead formulas.

F: Contract Billings

Labor	D1C1	
Overhead	D1F	= D1C1 * (F/C1)
	D1(C1+F)	

G: Delay Billings

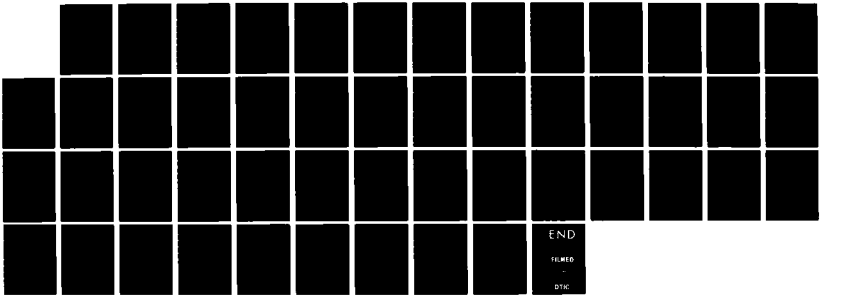
Labor	D2C2	
Overhead	D2C2F/C1	= (D2C2/C1) * (C1+F)
	D2C2(1+F/C1)	

H: Total Billings = (C1 + F)*[D1 + (D2C2/C1)]

Algebraic Example 1

The complete details of example one are contained in Chapter III and will not be repeated here. The main thrust of example one is that there is one employee and there is no work available during the delay period. So in example one, the true unabsorbed overhead is the daily overhead rate multiplied by the number of delay days. Using the variables, the actual unabsorbed overhead appears as F*D2 or FD2 or D2F . Also in example 1, C2=0 . With these in mind each formula was put into its algebraic form using the defined variables. These algebraic equations for example one are shown in the succeeding Tables numbered 4.1 through 4.6. In each block of each table, the algebraic simplification of the expression for that block appears at the bottom of the block.

AD-A161 710 CLAIMS FOR UNABSORBED OVERHEAD ON DEFENSE CONTRACTS(U) 2/2
AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL
OF SYSTEMS AND LOGISTICS T E EDEM SEP 85
UNCLASSIFIED AFIT/GSM/LSQ/85S-10 F/G 5/1 NL



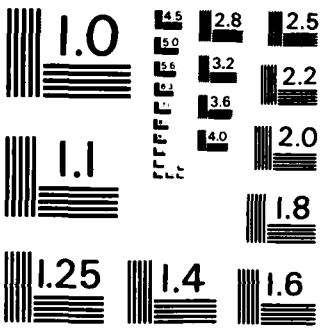


TABLE 4.1

	A		B		C		D		E
35					ALLEGHENY FORMULA				
36					---				
38	Incurred Overhead Rate	-			Incurred Overhead		=		Excess Rate of
39	During Actual Period				Rate for Projected				Overhead
40	(Original Plus Delay)				Performance Period				
41									
42	F(D1+D2) / (D1*C1)				(FD1) / (D1C1)				[F(D1+D2) / D1C1]
43									- (F / C1)
44									
48									
49	F(D1+D2) / (D1*C1)				F / C1				FD2 / (D1C1)
50									
51									
53	Excess Rate of		X		Base Costs of		=		Unabsorbed Overhead
54	Overhead				Contract				
55									
56	FD2 / (D1C1)				C1 * D1				[FD2 / (C1 * D1)]
57									* (C1 * D1)
58									
61									
62	FD2 / (D1C1)				C1D1				FD2

Footnotes: 1) Block A49 - see expression E - see page 83 note C2=0
2) Block C49 - see expression D - see page 83

TABLE 4.2

	A	B	C	D	E
			CARTERET FORMULA		
	Actual Overhead Rate Before Delay Period	X	Actual Labor Dollars During Delay Period	=	Anticipated Overhead During Delay Period
	F / C1		0		0
	F / C1		0		0
	Actual Overhead During Delay Period	-	Anticipated Overhead During Delay Period	=	Amount Claimed
	F * D2		0		(F * D2) - 0
	F * D2		0		FD2

TABLE 4.3

	G		H		I		J		K		L		M
					EICHLEAY FORMULA								
2													
3													
5	Original		/		Total Billings for		X		Total Overhead		=		Fixed Overhead
6	Contract				Actual Contract				Incurred During				Allocable
7	Price				Period				Actual Contract				to the Contract
8													
9	(D1*F)+(D1*C1)				(D1*F)+(D1*C1)				(D1*F)+(D2*F)				(D1*F)+(D1*C1)/
10													(D1*F)+(D1*C1)
11													*[(D1*F) +(D2*F)]
13													
18	(D1F) + (D1C1)				(D1F) + (D1C1)				D1F+D2F				D1F+D2F
19													
22	Allocable		/		Actual Days of		=		Overhead Allocable				
23	Overhead				Contract Performance				to Contract Per				
24									Day				
25													
26	D1F+D2F				D1+D2				D1F+D2F/				
27									D1+D2				
28													
34	D1F+D2F				D1+D2				F				
35													
38	Daily Overhead		X		Number of Days of		=		Unabsorbed Overhead				
39					Delay								
40													
41	F				D2				F * D2				
42													
47	F				D2				FD2				

Footnotes: Blocks G18, I18 - see F - H; page 84 note C2=0

TABLE 4.4

	A	B	C	D	E
70	ALLIED MATERIALS AND EQUIPMENT COMPANY FORMULA				
71					
73	Actual Cost	-	Bid Cost Burden	=	Fluctuation Burden
74	Burden Rate		Rate		Rate
75					
76	F(D1 + D2) / (D1 * C1)		F / C1		[F(D1 + D2) / D1C1] - (F / C1)
77					
78					
82					
83	F(D1 + D2) / (D1 * C1)		F / C1		FD2 / D1C1
84					
85					
87	Total Plant Labor	-	Contract Labor	=	Residual Labor
88					
89	D1C1		D1C1		(D1C1)-(D1C1)
90					
94					
95	D1C1		D1C1		(D1C1)-(D1C1)
96					
97					
99	Fluctuation Burden	X	Residual Labor	=	Unabsorbed Indirect
100	Rate				Factory Expense
101					
102	FD2 / D1C1		0		0
103					
104					
109	FD2 / D1C1		0		0

Footnotes: 1) Block E83 - same as Allegheny Block E49

TABLE 4.5

	A	B	C	D	E
115			A.C.E.S. FORMULA		
116			---		
118	Fixed Overhead Costs	/	Total Overhead Costs	=	Fixed Overhead Rate
119					
120	F(D1 + D2)		F(D1 + D2)		F(D1+D2) / F(D1+D2)
121					
122					
126					
127	F(D1 + D2)		F(D1 + D2)		1
128					
129					
131	Total Overhead Rate	X	Fixed Overhead Rate	=	Fixed Overhead Rate
132	Per Labor Hour				Per Labor Hour
133					
134	F / 8		1		(F / 8) * 1
135					
136					
140					
141	F / 8		1		(F / 8)
142					
143					
145	Lost Labor Man Hours	X	Fixed Overhead Rate	=	Unabsorbed Overhead
146			Per Labor Hour		
147					
148	8 * D2		F / 8		(8 * D2) * (F/8)
149					
150					
153					
154	8D2		F / 8		FD2

TABLE 4.6

	A	B	C	D	E	F	G
160			SIMULATION FORMULA				
161			---				
163	Contract Billings	/	Actual Days Worked	=	Average Contract		
164					Billings Per Day		
165					Worked		
166							
167	C1D1 + FD1		D1		(C1D1 + FD1) / D1		
168							
172							
173	C1D1 + FD1		D1		C1 + F		
174							
175							
177	Average Contract	X	Number of Days	=	Simulated Additional		
178	Billings Per Day		of Delay		Work		
179	Worked						
180							
181	C1 + F		D2		(C1 + F) * D2		
182							
186							
187	C1 + F		D2		D2(F + C1)		
188							
189							
191	Simulated	+	Contract Billings	=	Simulated Contract		
192	Additional Work				Billings		
193							
194	D2(F + C1)		C1D1 + FD1		C1D1 + C1D2 + FD1 +D2		
195							
199							
200	D2(F + C1)		C1D1 + FD1		C1(D1 + D2) + F(D1+D2)		

Table 4.6 Continued

204	Simulated	+ Total Billings	= Simulated Total	
205	Additional Work		Billings	
206				
207	D2(F + C1)	C1D1 + FD1	C1D1 + C1D2 + FD1 + D2	
208				
212				
213	D2(F + C1)	C1D1 + FD1	C1(D1 + D2) + F(D1 + D2)	
214				
215				
217	Simulated Contract	/ Simulated Total	X Total Home Office	= Overhead
218	Billings	Billings	Overhead During	Allocable to
219			Contract Period	Contract
220				
221	C1(D1 + D2)	C1(D1 + D2)	F(D1 + D2)	([C1(D1+D2)
222	+ F(D1 + D2)	+ F(D1 + D2)		+ F(D1+D2)]
223				/ [C1(D1+D2)
224				+ F(D1+D2)])
225				* F(D1 + D2)
226				
228	C1(D1 + D2)	C1(D1 + D2)	FD1 + FD2	FD1 + FD2
229	+ F(D1 + D2)	+ F(D1 + D2)		
230				
231				
232	Overhead Allocable	- Overhead Actually	= Unabsorbed Overhead	
233	to Contract	Allocated to Contract		
234				
235	FD1 + FD2	FD1	FD1 + FD2 - FD1	
236				
240				
241	FD1 + FD2	FD1	FD2	

Findings Example 1

The general setting for example 1 can be summarized as follows: 1) The only job the contractor has during during the originally planned contract period is the contract itself; 2) The contractor obtains no work during the delay period. It is this setting that has just been algebraically analyzed and the results can be summarized as shown in Figure 4.1 below.

	Understated Unabsorbed Overhead	Accurately Calculated Unabsorbed Overhead	Overstated Unabsorbed Overhead
Allegheny		X	
Carteret		X	
Eichleay		X	
Allied	X		
A.C.E.S.		X	
Simulation		X	

Figure 4.1 Example 1 Algebraic Results

As shown, each formula with the exception of Allied Materials and Equipment Company yielded the true unabsorbed. In the Allied Materials and Equipment Company formula the total plant labor equals the contract labor and thus residual labor becomes zero. If total plant labor was twice the size of contract labor then the formula would have given us the true unabsorbed. Obviously, in this very simple

example, Allied Materials and Equipment Company formula does not compute the actual unabsorbed overhead. From this first example it is not completely clear where the problem for this formula exists, except that total plant labor must be larger than just the particular contract in question. Thus the contractor must have more than one contract. In the simplest of cases, such as example 1 it has been shown that five of the six formulas do calculate the actual unabsorbed overhead.

Algebraic Example 2

The complete details of example two are included in Chapter 3 and will not be repeated here. The main thrust of this example is that there is one employee and that he works during half of the delay period. The true unabsorbed overhead in this case is then calculated as the number of days of delay minus the number of days that work was found, multiplied by the daily overhead rate. Using the defined variables the true unabsorbed overhead appears as (D2-D3)*F or (D2-D3)*F or D2F-D3F. Note that example 1 is then a special case of example 2. If D3=0, example 2 reduces to example 1.

With regard to the variables and expressions on page 81, recall that C2 = average daily direct labor during the D2 day delay period. In this example 2 then, C2 = (C1*D3)/D2 , or C2D2 = C1D3 .

C: Total daily period direct labor
= D2C2 or C1D3

E: Total extended period overhead
= F(D1+D2) / D1C1+D2C2
= F(D1+D2) / C1(D1+D3)

G: Delay Billings
= [(D2C2)/C1] *(C1+F) = D3(C1+F)

With these formulations in mind each formula was put into algebraic form to compare it with the actual unabsorbed. These algebraic equations for example two are shown in the succeeding Tables numbered 4.7 through 4.12.

TABLE 4.7

	A	B	C	D	E
35			ALLEGHENY FORMULA		
36			---		
38	Incurred Overhead Rate	-	Incurred Overhead	=	Excess Rate of
39	During Actual Period		Rate for Projected		Overhead
40	(Original Plus Delay)		Performance Period		
41					
42	[F(D1+D2)] /		FD1/C1D1		[F(D1+D2)] /
43	[C1(D1+D3)]				[C1(D1+D3)]
44					- [FD1 / C1D1]
47					
48					
49	[F(D1+D2)] /		F/C1		(FD2 - FD3) /
50	[C1(D1+D3)]				[C1(D1 + D3)]
51					
52					
53	Excess Rate of	X	Base Costs of	=	Unabsorbed Overhead
54	Overhead		Contract		
55					
56	(FD2 - FD3) /		C1D1		[F(D2-D3)/C1(D1+D3)]
57	[C1(D1 + D3)]				*C1D1
58					
61					
62	(FD2 - FD3) /		C1D1		[F(D2-D3)] *
63	[C1(D1 + D3)]				[D1 / (D1+D3)]

TABLE 4.8

	A	B	C	D	E
			CARTERET FORMULA		
	Actual Overhead Rate Before Delay Period	X	Actual Labor Dollars During Delay Period	=	Anticipated Overhead During Delay Period
	(F * D1) / (C1 * D1)		C1 * D3		[F * D1) / (C1 * D3)] * (C1 * D3)
	FD1 / C1D1		C1D3		FD3
	Actual Overhead During Delay Period	-	Anticipated Overhead During Delay Period	=	Amount Claimed
	FD2		FD3		FD2 - FD3
	FD2		FD3		F(D2 - D3)

TABLE 4.9

	G		H		I		J		K		L		M
2					EICHLEAY FORMULA								
3													
5	Original			/	Total Billings for		X		Total Overhead			=	Fixed Overhead
6	Contract				Actual Contract				Incurred During				Allocable
7	Price				Period				Actual Contract				to the Contract
8													
9	(F * D1) +				F(D1+D3) +				(F*D1)+(F*D2)				[(F*D1)+(C1*D1)]
10	(C1 * D1)				C1(D1+D3)								/ [F(D1+D3) +
11													C1(D1+D3)]
12													*[(F*D1)+(F*D2)]
13													
18	(FD1) + (C1D1)				F(D1+D3) +				FD1 + FD2				[F*D1*(D1+D2)]
19					C1(D1+D3)								/ (D1 + D3)
20													
22	Allocable			/	Actual Days of		=		Overhead Allocable				
23	Overhead				Contract Performance				to Contract Per Day				
25													
26	[F*D1*(D1+D2)]				D1 + D2				([F*D1*(D1+D2)]/(D1+D3))				
27	/ (D1 + D3)								/ (D1 + D2)				
28													
33	[F*D1*(D1+D2)]				D1 + D2				FD1 / (D1+D3)				
34	/ (D1 + D3)												
36													
38	Daily Overhead			X	Number of Days of		=		Unabsorbed Overhead				
39					Delay								
40													
41	FD1 / (D1+D3)				D2				(FD1 * D2)/				
42									(D1 + D3)				
43													
47	FD1 / (D1+D3)				D2				(FD1 * D2)/(D1 + D3)				

TABLE 4.10

	A		B		C		D		E
70	ALLIED MATERIALS AND EQUIPMENT COMPANY FORMULA								
71									
73	Actual Cost	-	Bid Cost Burden	=	Fluctuation Burden				
74	Burden Rate		Rate		Rate				
75									
76	F(D1+D2) /		FD1 / C1D1		[F(D1+D2) /				
77	[C1(D1+D3)]				[C1(D1+D3)]				
78					-[FD1 / C1D1]				
80									
81									
83	[F(D1+D2) /		FD1 / C1D1		(FD2 - FD3) /				
84	[C1(D1+D3)]				[C1(D1+D3)]				
85									
87	Total Plant Labor	-	Contract Labor	=	Residual Labor				
88									
89	C1(D1+D3)		C1D1		[C1(D1+D3)] - C1D1				
90									
95	C1D1 + C1D3		C1D1		C1D3				
96									
99	Fluctuation Burden	X	Residual Labor	=	Unabsorbed Indirect				
100	Rate				Factory Expense				
101									
102	(FD2 - FD3)		C1D3		[(FD2 - FD3) /				
103	(C1D1 + C1D3)				(C1D1 + C1D3)] * C1D3				
104									
109	(FD2 - FD3) /		C1D3		[D3(FD2-FD3)] /				
110	(C1D1 + C1D3)				(D1 + D3)				

TABLE 4.11

	A	B	C	D	E
115			A.C.E.S. FORMULA		
116			---		
118	Fixed Overhead Costs	/	Total Overhead Costs	=	Fixed Overhead Rate
119					
120	F(D1 + D2)		F(D1 + D2)		F(D1+D2) /
121					F(D1+D2)
122					
126					
127	F(D1 + D2)		F(D1 + D2)		1
128					
129					
131	Total Overhead Rate	X	Fixed Overhead Rate	=	Fixed Overhead Rate
132	Per Labor Hour				Per Labor Hour
133					
134	F / 8		1		(F / 8) * 1
135					
140					
141	F / 8		1		(F / 8)
142					
143					
145	Lost Labor Man Hours	X	Fixed Overhead Rate	=	Unabsorbed Overhead
146			Per Labor Hour		
147					
148	(D2-D3)8		(F / 8)		[(D2-D3)8] * [F / 8]
149					
153					
154	(D2-D3)8		(F / 8)		F(D2-D3)

TABLE 4.12

	A	B	C	D	E	F	G
160			SIMULATION FORMULA				
161			---				
163	Contract Billings	/	Actual Days Worked	=	Average Contract Billings Per Day Worked		
164							
165							
166							
167	FD1+C1D1		D1		(FD1+C1D1) / D1		
168							
172							
173	FD1+C1D1		D1		F + C1		
174							
175							
177	Average Contract	X	Number of Days	=	Simulated Additional		
178	Billings Per Day		of Delay		Work		
179	Worked						
180							
181	F + C1		D2		(F + C1) * D2		
182							
186							
187	F + C1		D2		D2(F+C1)		
188							
189							
191	Simulated Additional	+	Contract Billings	=	Simulated Contract Billings		
192	Work						
193							
194	D2(F+C1)		FD1 + C1D1		[D2(F+C1)] + (FD1 + FD1)		
195							
198							
199							
200	D2(F+C1)		FD1 + C1D1		(F+C1)(D1+D2)		

Table 4.12 Continued

Simulated Additional Work	+	Total Billings	=	Simulated Total Billings
D2(F+C1)		[F(D1+D3)] + [C1(D1+D3)]		[D2(F+C1)] + [F(D1+D3)] + [C1(D1+D3)]
D2(F+C1) * D2		[F(D1+D3)] + [C1(D1+D3)]		(F+C1)(D1+D2+D3)
Simulated Contract Billings	/	Simulated Total Billings	X	Total Home Office Overhead During Contract Period
(F+C1)(D1+D2)		(F+C1)(D1+D2+D3) + [D2(F+C1)]		F(D1 + D2)
(F+C1)(D1+D2)		(F+C1)(D1+D2+D3)		F(D1 + D2)
Overhead Allocable to Contract	-	Overhead Actually Allocated to Contract	=	Unabsorbed Overhead
[F(D1+D2)**2] / (D1+D2+D3)		FD1		([F(D1+D2)**2] / D1+D2+D3) - FD1
[F(D1+D2)**2] / (D1+D2+D3)		FD1		([F(D1+D2)**2] / D1+D2+D3) - FD1

Simulated Contract Billings	/ Simulated Total Billings
[F(D1+D2)**2] / (D1+D2+D3)	
[F(D1+D2)**2] / (D1+D2+D3)	

Findings Example 2

The general setting for example 2 can be summarized as follows: 1) The only job the contractor has during the originally planned contract period is the contract itself; 2) The contractor is fully employed at the contract level during part of the delay period. It is this setting that has just been algebraically evaluated and the results are summarized in Table 4.2 below.

	Understated Unabsorbed Overhead	Accurately Calculated Unabsorbed Overhead	Overstated Unabsorbed Overhead
Allegheny	X		
Carteret		X	
Eichleay			X
Allied	X		
A.C.E.S.		X	
Simulation			X

Figure 4.2 Example 2 Algebraic Results

As shown, four out of the six formulas did not calculate the true unabsorbed overhead. A closer look at each of the four formulas which did err will give a better understanding of why these formulas deviate from the actual unabsorbed overhead. In order to evaluate these formulas, the final simplified algebraic solution will be multiplied by X , an unknown, and then will be set equal to the true unabsorbed.

Allegheny Formula. The final simplified algebraic formula for Allegheny appears in block E62 of Table 4.7 which is:

$$F(D2-D3)*D1/(D1+D3)$$

By multiplying this by X and setting it equal to the true unabsorbed, the value of X is determined.

$$F(D2-D3)*[D1 / (D1+D3)] * X = F(D2-D3)$$

Dividing both sides by F(D2-D3) results in;

$$[D1 / (D1+D3)] * X = 1$$

Therefore X equals the inverse of D1/(D1+D3) , so

$$X = (D1 + D3) / D1$$

therefore,

$$X \geq 1$$

The value of X will only equal 1 when D3 is equal to zero, which was the result in example one. When D3 > 0, then X > 1 and the Allegheny formula underestimates the true unabsorbed overhead. So, the greater the amount of work obtained during the delay period, the greater Allegheny underestimates the true unabsorbed overhead.

Eichleay Formula. The final simplified algebraic formula for Allegheny appears in block K47 of Table 4.9 which is:

$$F * D1 * D2 / (D1 + D3)$$

By multiplying this by X and setting it equal to the true unabsorbed, the value for X is determined as shown below:

$$[(FD1 * D2) / (D1 + D3)] * X = FD2 - FD3$$

then,

$$X = [(FD2 - FD3)(D1 + D3)] / (FD1 * D2)$$

Since $D2-D3 = D2[1-(D3/D2)]$, X can be written as:

$$X = [1-(D3/D2)] * [(D1+D3)/D1]$$

or

$$X = [1-(D3/D2)] * [1+(D3/D1)]$$

Now assume $D2 < D1$, i.e. the delay period is shorter than the original contract period. Then

$$X = [1-(D3/D2)] * [1+(D3/D1)] < [1-(D3/D2)]$$

$$= 1-(D3/D2)**2 < 1$$

We conclude, assuming $D2 < D1$: a) The Eichleay formula overstates true unabsorbed overhead, because Eichleay * X = true unabsorbed overhead, and $X < 1$. b) Eichleay unabsorbed overhead * $[1-(D3/D2)] * [1+(D3/D1)]$ = true unabsorbed overhead. So, if D3=0, the Eichleay formula calculates true unabsorbed overhead as we saw in example 1. The larger the proportion, D3/D2 , the more Eichleay overestimates true unabsorbed overhead.

Allied Materials and Equipment Company Formula. The final simplified algebraic formula for Allied Materials and Equipment Company appears in block E109 of Table 4.10 which is:

$$[D3(FD2 - FD3)] / (D1 + D3)$$

By multiplying this by X and setting it equal to the true unabsorbed the value for X is determined as shown below.

$$[D3(FD2 - FD3)] / (D1 + D3) * X = FD2 - FD3$$

then,

$$X = [(FD2 - FD3)(D1 + D3)] / [D3(FD2 - FD3)]$$

and further simplification gives,

$$X = (D1 + D3) / D3$$

which shows that

$$X > 1$$

and therefore Allied Materials and Equipment Company formula underestimates the unabsorbed overhead. This formula only allows for a fraction of the actual unabsorbed, as can be seen from its final simplified form in block E109 of Table 4.10.

Simulation Formula. The final simplified algebraic formula for Simulation appears in Block E 241 of Table 4.12 which is:

$$\{[(D1+D2)(FD1+FD2)] / (D1+D2+D3)\} - FD1$$

But, with this formula it appears that in order to reach the true unabsorbed a quantity must be subtracted from the amount calculated by the formula. This quantity is not a multiplicative factor but must be determined in a different way. Thus, the following algebraic manipulations were employed:

$$\{[(D1+D2)(D1+D2)F] / (D1+D2+D3)\} - FD1$$

then a common denominator was found

$$F\{[(D1+D2)(D1+D2)-D1D1-D1D2-D1D3] / (D1+D2+D3)\}$$

which simplifies to

$$\text{Simulation} = F\{[D2**2 + D1(D2-D3)] / (D1+D2+D3)\}$$

So Simulation minus

$$F\{[D3^{**}2) / (D1+D2+D3)\}$$

$$= F\{[(D2^{**}2 - D3^{**}2 + D1(D2-D3)] / (D1+D2+D3)\}$$

This further simplifies to

$$F\{[(D2-D3)(D2+D3)+D1(D2-D3)] / (D1+D2+D3)\}$$

which simplified again is

$$F\{[(D2-D3)(D2+D3+D1)] / (D1+D2+D3)\}$$

$$= F(D2-D3)$$

which is true unabsorbed.

Therefore, Simulation minus $F(D3^{**}2) / (D1+D2+D3)$ equals true unabsorbed or $F(D2-D3)$. Thus, Simulation overestimates and its deciding factor is the number of days worked during the delay. As the number of days worked during the delay increases, Simulation overstates by a larger amount.

Algebraic Example 3

As with example one and two the complete details of example three are included in Chapter 3 and are not repeated here. The main emphasis behind this example is that there are two employees and that one works during half of the delay period. The true unabsorbed overhead in this case is then calculated by determining the total fixed overhead for the original contract plus the delay period. Then the amount of overhead that was absorbed or recovered is subtracted out.

The total overhead for the contract plus the delay in algebraic form is

$$F(D1+D2)$$

Now, as discussed in Chapter III, and on page 81 of this chapter, we assume overhead is recovered proportional to the direct labor incurred in a job, i.e. in accordance with a predetermined fixed overhead rate.

Then, total recovered on the contract is:

$$(F/C1)*(D1C1)=FD1$$

Total recovered during the delay period is:

$$(F/C1) * D2C2 = FD2 * (C2/C1)$$

Total recovered is:

$$F\ [D1 + D2 * (C2/C1)]$$

Thus,

$$\text{Unabsorbed} = F(D1+D2)-((D1F)+[D2*(C2/C1)*0])$$

$$= FD1 + FD2 - FD1 - [FD2 * (C2/C1)]$$

$$= FD2 - [FD2 * (C2/C1)]$$

Factoring out FD2 gives

$$[1 - (C2/C1)]FD2$$

This is the true unabsorbed algebraic formula for example three. Recall that in example 2, $C2=(C1*D3)/D2$ or $C2/C1=D3/D2$. Then $[1-(D3/D2)]FD2 = (D2-D3)F$, i.e. example 2 is a special case of this more general situation. If $C2=0$ (i.e. no work is obtained during the delay period), then this formula reduces to example 1. If $C2=C1$ (i.e. the average daily labor earned during the delay

period is the same as the average daily contract labor earning), then there is no unabsorbed overhead. In general, the larger C2 , the less unabsorbed overhead. Using the expressions of page 81, the algebraic equations for example three are shown in the following Tables numbered 4.13 through 4.18.

TABLE 4.13

A	B	C	D	E
		ALLEGHENY FORMULA		

Incurred Overhead Rate During Actual Period (Original Plus Delay)	-	Incurred Overhead Rate for Projected Performance Period	=	Excess Rate of Overhead
[F(D1+D2)] / D1C1+D2C2		F / C1		{[F(D1+D2)] / (D1C1+D2C2)) - (F / C1)
[F(D1+D2)] / D1C1+D2C2		F / C1		[FD2*(C1-C2)] / [C1(C1D1+C2D2)]
Excess Rate of Overhead	X	Base Costs of Contract	=	Unabsorbed Overhead
[D2*F*(C1-C2)] / [C1(C1D1+C2D2)]		C1 * D1		{[D2*F(C1-C2)] / [C1(C1D1+C2D2)]} * C1D1
[D2*F*(C1-C2)] / [C1(C1D1+C2D2)]		C1D1		[D1D2F(C1-C2)] / (C1D1+C2D2)

TABLE 4.14

	A	B	C	D	E
2			CARTERET FORMULA		
3			---		
5	Actual Overhead Rate	X	Actual Labor Dollars	=	Anticipated Overhead
6	Before Delay Period		During Delay Period		During Delay Period
7					
8	F / C1		D2 * C2		[F / C1] * [D2 * C2]
9					
12					
13					
14	F / C1		D2 * C2		[F * D2 * C2] / C1
15					
16					
18	Actual Overhead	-	Anticipated Overhead	=	Amount Claimed
19	During Delay Period		During Delay Period		
20					
21	FD2		[F * D2 * C2] / C1		[FD2] - [(F*D2*C2)/C1]
22					
25					
26					
27	FD2		[F * D2 * C2] / C1		FD2 * [1-(C2/C1)]

TABLE 4.15

	G		H		I		J		K		L		M
2					EICHLEAY FORMULA								
3													
5	Original		/		Total Billings for		X		Total Overhead		=		Fixed Overhead
6	Contract				Actual Contract				Incurred During				Allocable
7	Price				Period				Actual Contract				to the Contract
8													
9	FD1 + C1D1				FD1 + C1D1 +				FD1 + FD2				[(FD1+C1D1)*
10					[F*(C2/C1)*D2]								(FD1+FD2)]
11					+ C2D2								/(FD1+C1D1+
12													[FD2*(C2/C1)]
13													+C2D2)
14													
18	D1(F+C1)				(C1+F) *				FD1 + FD2				D1*F(D1+D2)
19					[D1+(D2C2/ C1)]								/ [D1+(D2C2/C1)]
21													
22	Allocable		/		Actual Days of		=		Overhead Allocable				
23	Overhead				Contract Performance				to Contract Per Day				
24													
26	D1*F(D1+D2)				D1 + D2				D1*F(D1+D2) / [D1+				
27	/[D1+(D2C2/C1)]								(D2C2/C1)] / (D1 + D2)				
28													
34	D1*F(D1+D2)				D1 + D2				D1 * F /				
35	/[D1+(D2C2/C1)]								[D1 + (D2C2/C1)]				
36													
38	Daily Overhead		X		Number of Days of		=		Unabsorbed Overhead				
39					Delay								
40													
41	D1 * F				D2				(D1*F/[D1+(D2C2/C1)])				
42	/ [D1+(D2C2/C1)]								* D2				
43													
47	D1 * F				D2				D2 * D1 * F				
48	/ [D1+(D2C2/C1)]								/ [D1 + (D2C2/C1)]				

TABLE 4.16

	A		B		C		D		E
70	ALLIED MATERIALS AND EQUIPMENT COMPANY FORMULA								
71									
73	Actual Cost	-	Bid Cost Burden	=	Fluctuation Burden				
74	Burden Rate		Rate		Rate				
75									
76	[F(D1+D2)] /		F / C1		[[(D1+D2)F] /				
77	[D1C1 + D2C2]				[D1C1 + D2C2]] - [F/C1]				
78									
83	[F(D1+D2)] /		F / C1		(C1D2F-C2D2F)/				
84	[D1C1 + D2C2]				[C1(C1D1+C2D2)]				
85									
86									
87	Total Plant Labor	-	Contract Labor	=	Residual Labor				
88									
89	C1D1 + C2D2		C1D1		(C1D1 + C2D2) - (C1D1)				
90									
95	C1D1 + C2D2		C1D1		C2D2				
96									
97									
99	Fluctuation Burden	X	Residual Labor	=	Unabsorbed Indirect				
100	Rate				Factory Expense				
101									
102	(C1D2F-C2D2F)/		C2D2		((C1D2F-C2D2F)/				
103	[C1(C1D1+C2D2)]				[C1(C1D1+C2D2)]]				
104					* C2D2				
105									
109	(C1D2F-C2D2F)/		C2D2		((C1D2F-C2D2F)/				
110	[C1(C1D1+C2D2)]				[C1(C1D1+C2D2)]]				
111					* C2D2				

TABLE 4.17

	A	B	C	D	E
115			A.C.E.S. FORMULA		
116			---		
118	Fixed Overhead Costs	/	Total Overhead Costs	=	Fixed Overhead Rate
119					
120	F(D1+D2)		F(D1+D2)		[F(D1+D2)] /
121					[F(D1+D2)]
125					
126					
127	F(D1+D2)		F(D1+D2)		1
128					
131	Total Overhead Rate	X	Fixed Overhead Rate	=	Fixed Overhead Rate
132	Per Labor Hour				Per Labor Hour
133					
134	F / 8		1		[F / 8] * 1
139					
140					
141	F / 8		1		F / 8
142					
145	Lost Labor Man Hours	X	Fixed Overhead Rate	=	Unabsorbed Overhead
146			Per Labor Hour		
147					
148	2(D2*8*[1-(C2/C1)])		F / 8		(2(D2*8*[1-(C2/C1)]))
149					* (F / 8)
152					
153					
154	2(D2[1-(C2/C1)]8)		F / 8		2(D2[1-(C2/C1)F)
155	* (F/8)				

FOOTNOTE: For Block 154, see page 121

TABLE 4.18

SIMULATION FORMULA

A	B	C	D	E	F	G
Contract Billings	/	Actual Days Worked	=	Average Contract Billings Per Day Worked		
FD1 + C1D1		D1		(FD1 + C1D1) / D1		
FD1 + C1D1		D1		F + C1		
Average Contract Billings Per Day Worked	X	Number of Days of Delay	=	Simulated Additional Work		
F + C1		D2		(F + C1)D2		
F + C1		D2		(F + C1)D2		
Simulated Additional Work	+	Contract Billings	=	Simulated Contract Billings		
(F + C1)D2		FD1 + C1D1		[D2(F + C1)] + FD1 + C1D1		
FD2 + C1D2		FD1 + C1D1		(F+C1)(D1+D2)		

Table 4.18 Continued

204	Simulated Additional	+	Total Billings	=	Simulated Total Billings	
205	Work					
206						
207	(F + C1)D2		FD1 + C1D1 + [F*(C2/C1)*D2]		(F + C1)D2 + FD1 +C1D1	
208					+ [F*(C2/C1)*D2] +C2D2	
209			+ C2D2			
210						
213	FD2 + C1D2		FD1 + C1D1 + [F*(C2/C1)*D2]		(F+C1)[D1+D2+(D2C2/C1)]	
214						
215			+ C2D2			
216						
217	Simulated Contract	/	Simulated Total	X	Total Home Office	= Overhead
218	Billings		Billings		Overhead During	Allocable
219					Contract Period	to Contract
220						
221	(F+C1)(D1+D2)		(F+C1)[D1+D2+		F(D1 + D2)	[[(F+C1)(D1+D2)]
222						/(F+C1)[D1+D2+
223						(D2C2/C1)]]
224						*[F(D1+D2)]
225						
228	(F+C1)(D1+D2)		(F+C1)[D1+D2+		F(D1+D2)	[F(D1+D2)(D1+D2)]
229	C1D2		(D2C2/C1)]			/[D1+D2+(D2C2/C1)]
231						
232	Overhead Allocable	-	Overhead Actually	=	Unabsorbed Overhead	
233	to Contract		Allocated to Contract			
234						
235	[F(D1+D2)(D1+D2)]		FD1		[[F(D1+D2)(D1+D2)]	
236	/ [D1+D2+(D2C2/C1)]				/ [D1+D2+(D2C2/C1)]]	
237					- FD1	
238						
241	[F(D1+D2)(D1+D2)]		FD1		[[F(D1+D2)(D1+D2)]	
242	/ [D1+D2+(D2C2/C1)]				/ [D1+D2+(D2C2/C1)]]	
243					- FD1	

Findings Example 3

The general setting for this final example 3 can be summarized as follows: 1) The only job the contractor has during the originally planned contract period is the contract. 2) During the delay period, some work is obtained. The extent of this work is measured by the ratio, C2/C1 ; average daily labor costs during the delay period, divided by average daily contract labor costs. The preceding algebraic analysis can be summarized as shown below in Table 4.3.

	Understated Unabsorbed Overhead	Accurately Calculated Unabsorbed Overhead	Overstated Unabsorbed Overhead
Allegheny	X		
Carteret		X	
Eichleay			X
Allied	X		
A.C.E.S.			X
Simulation			X

Figure 4.3 Example 3 Algebraic Results

As shown above, five out of the six formulas did not calculate the true unabsorbed overhead. Each of the formulas will now be evaluated to determine why the formula deviates from the true unabsorbed. In the case of the Carteret formula a further thought will show why even this

formula will not work in all cases.

Allegheny Formula. In order to evaluate where the Allegheny formula deviates from true unabsorbed it is necessary to manipulate the algebraic equation found in Table 4.13, Block E 62. This manipulation is done by dividing the numerator and denominator by C1 and is shown below.

Unabsorbed = [D1D2F(C1-C2)] / (C1D1 + C2D2)

Dividing both the numerator and the denominator by C1 gives

Unabsorbed =D1D2F[1-(C2/C1)] / [D1 + (C2/C1)D2]

It can be seen from this equation that the true unabsorbed is part of this formula, D2F[1-(C2/C1)] . So the total Allegheny formula is D1/[D1+(C2/C1)D2] times true unabsorbed, which gives us a fraction of the actual unabsorbed overhead. Taking a look at the inverse of this fraction explains what the Allegheny formula does inaccurately.

[D1 + (C2/C1)D2] / D1

This simplifies into

1 + (C2D2) / (C1D1)

The inverse is 1 + the ratio, total labor cost during the delay period divided by the total labor cost during the actual contract period. So, Allegheny computed unabsorbed, times 1 plus the ratio, is the true unabsorbed. The more work that is done during the delay period, the greater the ratio. Consequently, as more work is obtained during the

delay period, the Allegheny formula becomes a smaller fraction of the true unabsorbed overhead.

Carteret Formula. The Carteret formula does calculate the true unabsorbed in this example, but this will not always be the case. Take example three, for instance, and extend the problem. Assume the government contract is half completed when the second shipment of chalkboards is delayed, and the delay lasts for 80 work days. While the government contract was on going, the contractor had a job with a civilian firm that added two employees to his work force. This contract is started shortly after the government contract and causes the actual overhead rate before the delay period to fall because of additional employees. Assume the actual rate falls to 1.00, and this civilian contract is finished the week before the government contract is delayed.

Using the new overhead rate of 1.00 in Block A14, Table 3.14, Block E14 becomes 2240.00. The actual overhead during the delay period remains 11,200.00 in Block A27, but in Block C27 2240.00 is now the anticipated overhead and the amount claimed becomes 8960.00. With this in mind, it becomes clear that with more than one contract being performed during the originally planned government contract period, the Carteret formula will overestimate the true unabsorbed overhead.

Eichleay Formula. In order to evaluate where the

Eichleay formula deviates from true unabsorbed, it is necessary to manipulate the algebraic equation found in Table 4.15, Block K47. The formula there was

$$\text{Eichleay} = (D2 * D1 * F) / (D1 + [D2(C2/C1)])$$

Multiplying numerator and denominator by C1 gives

$$FD2(C1D1) / (C1D1 + C2D2)$$

Then multiplying this formula by X and setting it equal to the true unabsorbed gives

$$[FD2C1D1 / (C1D1 + C2D2)] * X = D2[1-(C2/C1)]F$$

Dividing both sides by D2F gives

$$[C1D1 / (C1D1+C2D2)] * X = [1-(C2/C1)]$$

Dividing through by C1D1 and multiplying by (C1D1+C2D2) gives

$$[1-(C2/C1)] * (C1D1+C2D2) / C1D1 = X$$

This can now be looked at as two factors

$$[1-(C2/C1)] * [1 + (C2D2/C1D1)] = X$$

From this we can conclude that Eichleay misses the true unabsorbed overhead by a product of factors. One factor is one minus the ratio of the average daily direct labor during the delay period and the average daily labor during the originally scheduled contract period. The other factor is one plus the ratio of the total labor cost during the delay divided by the total labor cost during the original contract period.

Now it is shown that $X<1$, which proves that Eichleay overestimates unabsorbed overhead. C2/C1 is greater than

C2D2/C1D1 as long as the original contract period is longer than the delay period. This means that when the two factors are multiplied together the product will be less than one. In algebraic symbols

$$1+(C2D2/C1D1) < 1+(C2/C1)$$

so

$$X < [1-(C2/C1)] * [1+(C2/C1)]$$

$$= 1-(C2/C1)**2 < 1$$

Eichleay overestimates and this will always be the case unless the delay period is longer than the original contract period. If C2=0 (i.e. no work is obtained during the delay period), X=1; or the Eichleay formula accurately computes unabsorbed overhead. This was the conclusion of example 1, as the ratio of work obtained during the delay period to work during the contract period (as measured by C2/C1) increases, the factor X decreases. That is, as the amount of work found during the delay period increases the true unabsorbed becomes a smaller fraction of the Eichleay computed unabsorbed overhead.

Allied Materials and Equipment Company Formula. This formula is approached in the same manner as the Allegheny formula. Taking the final simplified formula from Table 4.16, Block E109 it shows

$$\text{Allied} = ((C1D2F-C2D2F)/[C1(C1D1+C2D2)])*(C2D2)$$

Rearranging this gives

$$[C2D2 * D2F(C1-C2)]/[C1(C1D1+C2D2)]$$

Now dividing numerator and denominator by C1 gives

$$C2D2 * D2F[1-(C2/C1)]/(C1D1+C2D2)$$

As can be seen, the numerator, $D2F[1-(C2/C1)]$, is the true unabsorbed and thus $C2D2/(C1D1+C2D2)$ gives the fraction by which the true unabsorbed is being multiplied by to calculate the Allied Materials and Equipment Company amount.

The fraction consists of the total labor cost during the delay period divided by the total labor cost during the original contract period plus the delay period. Therefore, the Allied Materials and Equipment Company formula will always underestimate the actual unabsorbed overhead. If total labor cost during the delay period is small, compared to total labor cost during the contract period, the Allied formula computes a small fraction of the true unabsorbed overhead.

A.C.E.S. The formula in Block 154, Table 4.17 can be derived as follows with 2 employees; (with more employees the generalization is clear): For the A.C.E.S. formula to be applicable at all in Example 3, it is necessary that both employees be paid the same rate. Otherwise, the phrase, "lost labor hours", makes no sense. Assume employee 1 works K1 and employee 2 works K2 of the D2 day delay period. Then,

$$C2 = (K1+K2) / D2 \quad \text{(ignoring the daily rate)}$$

$$C1 = (D1+D1) / D1 = 2$$

So,

$$C2/C1 = (K1+K2) / 2 * D2$$

The factor in Block 154, $2(D2[1-(C2/C1)]8)$ can be expressed as $(2D2-K1-K2)8$, or $8(D2-K1+D2-K2)$, the number of lost labor hours.

Thus, multiplying the simplified A.C.E.S. formula located in Table 4.17, Block E154 by X and setting it equal to the true unabsorbed gives the following:

$$2(D2[1-(C2/C1)]F) * X = D2F * [1-(C2/C2)]$$

therefore

$$X = (D2F*[1-(C2/C1)]) / 2(D2[1-(C2/C1)]F)$$

which simplifies to

$$X = 1/2$$

When $X<1$, the formula overestimates the true unabsorbed. Therefore, the A.C.E.S. formula over calculates unabsorbed overhead when additional work for employees is found during a delay period. There appears to be a factor missing in this formula, lost labor man hours should be divided by the number of employees. Thus, as the A.C.E.S. formula stands, it will always overestimate unabsorbed overhead under the example 3 conditions.

Simulation. The final simplified Simulation algebraic formula found in Table 4.18, Block E241 was

$$[[(D1+D2)F * (D1+D2)] / [D1+D2+(D2C2/C1)]] - FD1$$

Putting this expression over a common denominator, we get Simulation equals

$$(D2**2 + D1D2[1-(C2/C1)]) / [D1+D2+(D2C2/C1)]$$

Using a technique analogous to the technique used in example 2, subtract

(D2C2/C1)**2 / [D1+D2+(D2C2/C1)]

from this equation for the Simulation method unabsorbed. After some rearrangement of terms, it can be shown that:

Simulation unabsorbed - (D2C2/C1)**2 /

[D1+D2+(D2C2/C1)] = true unabsorbed

Here, also we conclude that the Simulation method tends to overestimate true unabsorbed overhead. As total labor cost during the delay period (i.e. D2C2) increases, the Simulation method more overestimates true unabsorbed overhead.

V. Conclusions and Recommendations

Summary of Findings

Unabsorbed overhead claims due to government caused delays have been inequitably determined by various formulas. The formulas covered in this research were the Allegheny, Carteret, Eichleay, Allied Materials and Equipment Company, A.C.E.S., and a new non-court tested formula called Simulation. Yet, with the exception of Carteret they all fall short of calculating the true unabsorbed overhead using simple examples which portray situations of much larger cases.

The idea of breaking this problem, of formula calculated unabsorbed overhead, down into simple examples proved to be very beneficial. From each of these simplified examples that portray larger scale problems the actual or true unabsorbed overhead was calculated. The ability to calculate the true unabsorbed is still the goal. In these three examples it was possible to calculate the true unabsorbed overhead, but not all "real world" circumstances have been covered in these three examples. It has been shown that none of the common formulas is generally accurate. The algebra of example 3 plus the discussion of the Carteret formula show them all to be inaccurate in a general scenario.

The formula that is most widely used was shown through

Example two and Example three that it will always overestimate true unabsorbed overhead. That formula is the Eichleay formula, so it is no wonder contractors consistently recommend the Eichleay formula in their settlement claims. The biggest error is that the BCA's are backing Eichleay because it has been used in the past and has settled many claims, and therefore it has built a precedence. Also, it has been shown that a popular DCAA model, the Allegheny formula, consistently understates true unabsorbed overhead in the scenarios presented. With the Eichleay and Allegheny formulas computing extreme amounts, it is not surprising that so many disputes over unabsorbed overhead "go to court".

Each investigated formula was found to have particular faults, conditions causing them to err from the true unabsorbed. The Allegheny formula shows that as additional work is obtained during the delay, the smaller the ratio of true unabsorbed is calculated. The Carteret formula did calculate the true unabsorbed within these examples, but it still ha a fault where changing overhead rates can cause overestimates. Eichleay, as stated before, overestimates and it shows that the greater the amount of work obtained during the delay period, the greater the overestimate of true unabsorbed. The Allied Materials and Equipment Company formula calculates a fraction of the true unabsorbed overhead. This fraction is total labor cost during the

delay divided by total labor cost of the original contract period plus total labor cost during the delay. Thus, this fraction can approach 1, but it will never reach it. The A.C.E.S. formula overestimates true unabsorbed overhead when during a delay all the employees affected are not able to be use elsewhere by the contractor. Finally, Simulation overestimates true unabsorbed overhead by a larger amount as the total labor cost during the delay period increases.

Conclusion

This research has not attained a true unabsorbed overhead formula for all circumstances, but it now appears that this is possible. It has shown that the commonly used formula, Eichleay, does overestimate the quantum for unabsorbed overhead. There is more work to be done in this area of research, in order to change the way unabsorbed overhead is determined after a delay. But, this research should be the beginning of a new way of looking at and solving this situation. A consistent approach to calculating unabsorbed overhead for government caused delays is still the final goal in the quest of solving this problem.

Recommendations for Future Study

In order to calculate true unabsorbed overhead for all different situations that exist, at least one more example should be examined. This example should include two or more

employees who work for a particular contract which will have a government caused delay. Also, at the same time this contractor has another contract with one or more employees who are paid on a different scale than the ones who work on the delayed contract. This second contract is not delayed and the work continues on this contract while the other contract is in its delay period. With this situation examined and the true unabsorbed overhead formula invented through the use of an algebraic equation, the problem will be solved on the surface.

From this point the new unabsorbed overhead formula must be accepted by contracting officers who must render final decisions with contractors. At the same time, trial attorneys at AFLC/JAB will have to be convinced that this is a better formula. With proper preparation this new formula will have to be tested before BCA's and the judges must understand the principles behind the origination of this new formula. If further appeals are made, this same understanding must prevail up the chain of Appeal Courts in order for a precedent to be established.

Further thoughts about this issue concern the applicability of putting a clause into every contract. Should or can a clause with the new unabsorbed overhead formula be placed into every contract? This issue must be debated and individuals with contract law backgrounds must be involved. This possibility should be investigated,

because the amount of monetary savings could be quite large. Less would be paid out in delay claims because as shown, the true unabsorbed is less than Eichleay, the most widely used approach, and with a contract clause, these claims would no longer be heard before courts of Appeal.

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This research effort investigated the Allegheny, Carteret, Eichleay, Allied Materials and Equipment Company, A.C.E.S. and Simulation formulas that were used or recommended to determine quantum on unabsorbed overhead claims. These claims arise from contracts that have been delayed by the government. When the government contracting officer and the contractor cannot come to an agreement, there is a claim filed by the contractor to the appropriate Board of Contract Appeals. These formulas investigated were the product of different claims heard before the appropriate Board of Contract Appeals, with the exception of one, the Simulation formula.

The analysis was accomplished by developing very basic examples which portray different aspects of the real world. Three examples were created, each one more extensive than the preceding. Then the true unabsorbed for each example was calculated. By using algebraic equations, each formula in this form was equated to the true unabsorbed. From this it was shown that the Allegheny and Allied Materials and Equipment Company formulas generally underestimate the true unabsorbed overhead. It also showed that the Eichleay, A.C.E.S. and Simulation formulas generally overestimate true unabsorbed overhead. The Carteret formula did equate to the true unabsorbed overhead in each example, but not all real world situations were covered within this research. At least one more complexity needs to be examined.

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